A N K Y L O S I N G S P O N D Y L I T I S.

with special reference to its treatment

by X-ray Therapy.

Thesis submitted for degree of M.D.

by

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ANKYLOSING SPONDYLITIS.

In this Thesis I have made a study of the aetiology, the symptomatology and the clinical and radiological signs presented by a series of cases of ankylosing spondylitis which I have personally observed.

The treatment policy adopted is described and an attempt is made to assess the value of this treatment in relieving symptoms and in arresting the disease.

Historical and pathological notes on the disease are included and recent advances in its aetiology and treatment are discussed.

The Thesis has been compiled under the following main headings:-

1. Definition of the Disease

2. Historical note.

3. Note on Pathology.

4. Cases observed with a study of the aetiological factors.

5. Symptomatology.

6. Physical signs.

7. Radiological findings.

8. Haematological and biochemical examinations.

9. Treatment policy discussed under the sub-headings:
    a. General Treatment.
    b. Radiological Treatment.
    c. Orthopaedic Treatment.

10. Results of treatment discussed under sub-headings:
    a. Immediate.
    b. Late.
    c. Capacity for work.
    d. Opinion on the value of Treatment in arresting disease.

11. Recent Advances in a. Aetiology.

b. Treatment.

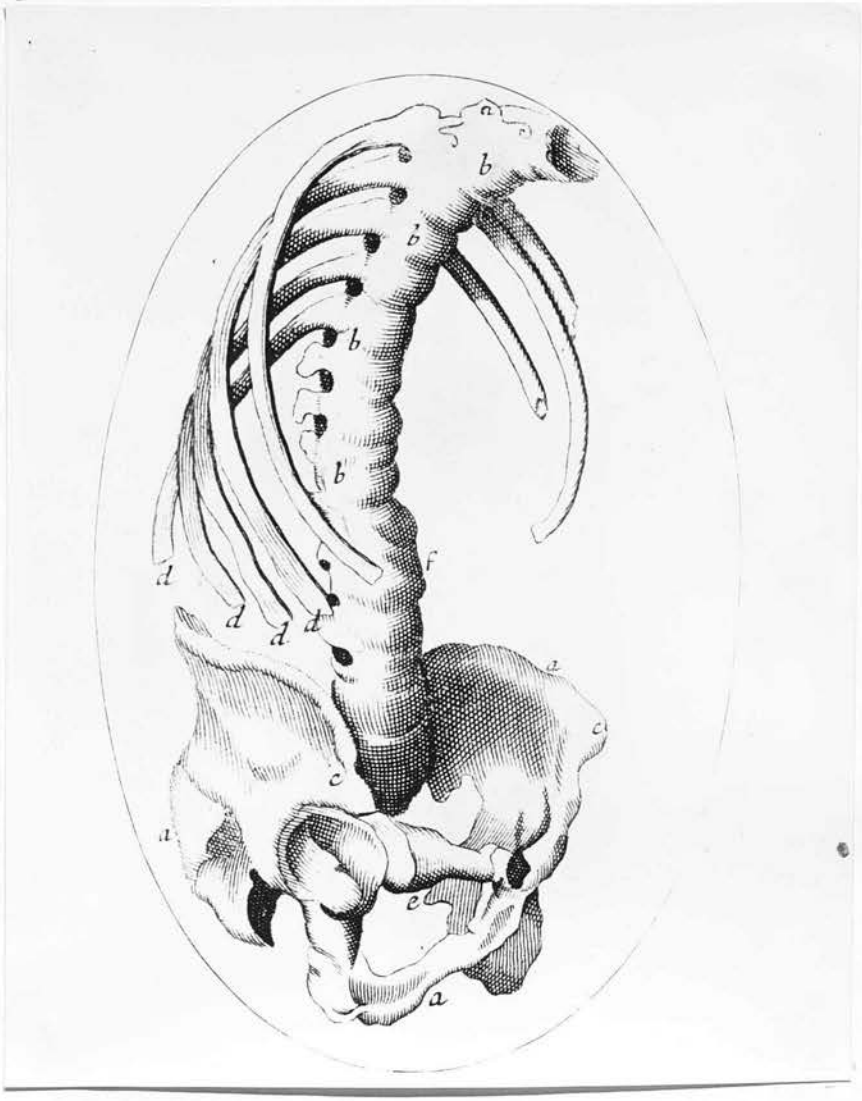
12. Summary and Conclusions.

13. References.

ANKYLOSING SPONDYLITIS.

DEFINITION.

A chronic progressive arthritis involving the sacro-iliac and spinal articulations, and less frequently the joints of the limbs, and proceeding to ankylosis in the affected joints.



Photograph of Dr. Bernard O'Connor's case showing bony union of the vertebral bodies and fusion of the ribs to the vertebrae.

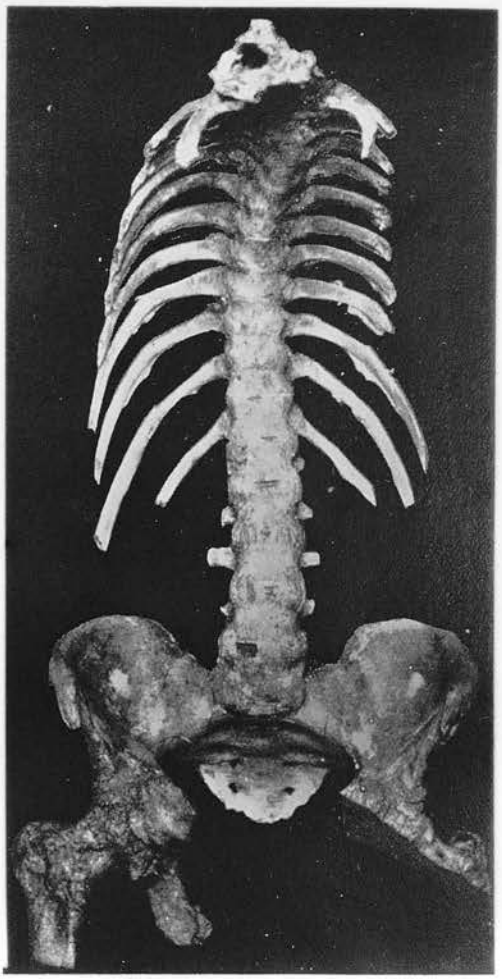
HISTORICAL NOTE:

The first record of this disease was made by an Irishman by the name of Bernard O'Connor in 1691. He wrote a thesis for the M.D. of Rheims which he entitled "sur la continuité de plusieurs os, à l'occasion d'un tronc de squelette humain, où les vertèbres, les côtes, l'os sacrum, et les os des iles qui naturellement sont distinct et séparez, ne font qu'un seul os continu et inséparable." In this thesis he described a skeleton in which the vertebrae were joined together, the ligaments bony and the sacro-iliac joints, the posterior spinal articulations and the costo-spinal articulations all fused. He noted that the intervertebral discs were ossified at their circumferences but not in the central part.

No other cases seem to have been recorded

till the latter part of the nineteenth century when attention was focussed on this condition by the report of a necropsy by Hilton Fagge[20] in 1877. He noted destruction of the intervertebral joints and bony ankylosis of the articular processes so that cancellous tissue passed from one vertebra to the next. The bodies of the vertebrae were so soft they could be cut with a knife. The ribs were ankylosed to the vertebrae from head to tubercle which was also fixed to the transverse process.

In 1883 Bradford reported three cases of "rheumatism of the spine" in the Annals of Anatomy and Surgery (1883, Vol. 7, p.6). In two of the cases the whole spine was rigid and the costo-vertebral joints were ankylosed. In all the cases there was a past history of a gonococcal infection.



Museum specimens of cases of ankylosing spondylitis. Note the fusion of the vertebral bodies, the costo-vertebral joints and the sacro-iliac joints.

Up till 1893 all records of the disease had been made on post-mortem specimens. In this year, however, Bechterew (Neurol. Centralblatt 1899 vol. 18 p. 143) reported five cases - three men and two women. The three men had complete ankylosis of the spine with symptoms of root pressure in the cervical region, producing anaesthesia and paraesthesia in the arms. In the women the dorsal and cervical regions of the spine were rigid but no other joints were affected.

In 1897 Strumpell (Deutsche. Zeitschr. fur Nervenkranken 1897 p. 338) reported on three patients who appeared to have progressive rigidity of the spine and hip joints.

In 1898 Marie published his classical description (Rev. de med. 1898 vol. 18, p. 285) of the disease and reported five cases. The descriptions which he gave

were extremely detailed and accurate, and in all the cases the progress of the disease was studied over a number of years. Although Marie was not the first person to describe the disease his writings give a more lucid description of the natural history of the disease, and of the clinical picture in the advanced stage than any of his contemporary writers. He also discusses the points in differential diagnosis from Pott's disease and from other causes of spinal kyphosis. There is little that could be added to-day to his clinical observations, and when one considers that they were made without the aid of radiological science, it seems all the more remarkable. Most of the cases which he described were in an advanced stage with involvement of the hip and shoulder joints, and it was because of this involvement of the joints at the roots of the limbs that he referred to the disease under the name of "spondylitis rhizomelique".

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After Marie had drawn attention to the disease numerous other reports appeared of individual cases that had been observed.

Thus Mutterer (Deutsche. Ztschr. fur Nervenkranken. 1898 Bd 14) reported the case of a man of 58 with complete ankylosis of the spine and both hips, and S. Popoff (Neul Centralbl. Vol. 18, p. 294 1899) reported a case in a man of 28 in whom the disease developed rapidly.

Although the diseases described by Marie and Strumpell, and by Bechterew were regarded as the same pathological process the two diseases were considered to be different forms or types. In the older medical text-books a contrast was drawn between the Bechterew type and the Marie-Strumpell type. The Bechterew type was said to affect the upper thoracic region of the

spine and produced a dorsal kyphosis. It was associated with root pain, muscle wasting and some sensory disturbance in the arms. The Marie-Strumpell type, on the other hand, affected the lumbar region and produced lumbar pain and rigidity, and at a later stage a poker-back. This distinction was made by Lawford Knaggs[40] writing in 1926 in his Textbook on diseases of bone. He recognised two types of spondylitis:-

(1) Spondylitis ossificans ligamentosa (Marie-Strumpell type or spondylitis rhizo-melique)

(2) Spondylitis muscularis (Bechterew type, spondylitis heredo-traumatique).

The B.M.A. Arthritis Committee report of 1933, however, criticised the separation of the disease into the two forms and regarded them simply as different stages of the same disease. C. W. Buckley in his report on

chronic rheumatic diseases (Report of British Committee appointed R.C.P.) says "the various types Bechterew, Strumpell, Marie etc., are simply variations in the location of the inflammation which may be acute or chronic, transient or progressive." When one sees large numbers of these cases one feels that there is little doubt that this is the correct view, and that although symptoms may be referred by the patient to one or other section of the spine the disease in all cases pursues a similar course.

The term spondylitis ankylopoetica was coined by Fraenkel[23] in 1904 when he gave a full account of the disease.

Radiology has helped considerably in the study of this disease but it was not till radiographic technique and X-ray tube design gave a sharp definition of the

sacro-iliac and spinal joints that we were able to recognise the disease in its early stages. It was several years also before it came to be recognised that bilateral sacro-iliac arthritis represented the early stage of the disease, and was followed later by spinal involvement.

NOTE ON PATHOLOGY.

It is now generally agreed that the disease starts in the sacro-iliac joints and from there spreads to the lower lumber region of the spine and thence upwards in a caudo-cephalic direction. Although this point has only recently been noted it is well borne out by the radiological observations of the cases which I have treated. Thus,

Total number of cases	164
Sacro-iliac joints involved in	164
Sacro iliacs with lumbar spine	147
Sacro iliacs with lumbar spine and dorsal spine	120
Sacro iliacs with whole length of spine	58

From these figures it will be seen that the sacro-iliac joints were involved in every case and the incidence of involvement decreased as one ascended from the lumbar to the cervical regions. In no case was involvement of a

section of the spine discovered without involvement at a lower level. Spread to the hip and shoulder joints usually takes place at a late stage of the disease when the greater part of the spine is already involved.

Information on the pathology of ankylosing spondylitis is scanty and what is available is derived from post-mortem material and radiological examination. While there are numerous reports on the morbid anatomy of the advanced disease, very few cases of the early stages of the disease are recorded in the literature. In his original description in 1691, O'Connor states "All the bones which are naturally separate and distinct from one another were here so straightly and intermittently joined, their ligaments perfectly bony, and their articulations so effaced that readily made one uniform and continuous bone, so that it was as easy

to break one of the vertebrae in two as to separate it from the other vertebrae, or the os sacrum from the ilia. The roots of the ribs made but one equal, smooth, and plain superficies with the vertebrae and their apophyses. The cartilaginous edges of the vertebrae themselves were turned to perfect bone. But when I sawed two of the vertebrae asunder at the commissure I found that this uniting did not enter above two lines deep, their middles were separated as they usually are and touched each other only at their edge, which was raised up a little above the middle part".

This description which has been repeated by many observers corresponds to the advanced condition as seen in the post-mortem room. There are few reports on the histological changes seen in the early case but records of single cases have been made by Fraenkel,[24] Schmorl and Guntz.[31] Recently Freund[25] recorded the findings in the case of a man who died of hypernephroma and at post-mortem was also found

to have spondylitis. Microscopic examination showed that all elements of the spinal articulation were involved in the pathological change. Connective tissue proliferation and round cell infiltration which appears to start in the region of the capsule of the joint spreads over the surface of the articular cartilage like a pannus and gradually invades the cartilage by lacunar erosion. There is also proliferation of connective tissue under the cartilage which is thus attacked from both sides. Eventually the two areas of proliferating connective tissue coalesce and destroy the cartilage. Fibrous tissue also extends across the joint and produces a fibrous ankylosis. Eventually bone develops within the fibrous tissue and a bony ankylosis is the final result.

When the intervertebral joints become fused an elastic intervertebral disc no longer serves any useful purpose and the elastic tissue of the disc gradually becomes replaced by inert vascular fibrous tissue and new bone may also form at the margin of the vertebral body.

CASES OBSERVED.

My experience is based on a total of 164 cases, which I had seen up to the beginning of 1950. I was fortunate in having the opportunity to see and treat such a large number of cases. This was due to the fact that the Radiotherapy Unit in which I work drains a large Midland population, and also because of the courtesy of my colleagues who allowed me to examine and supervise the treatment of all of their cases. All the patients were treated between the years 1945 and 1949, except a few of the earlier cases that were not seen before treatment but were reviewed a short time afterwards. The number of patients treated during the years were/

years were

1944	8
1945	7
1946	21
1947	36
1948	41
1949	45
1950	6
	Total 164

Previous to 1944 no cases of spondylitis were treated by X-ray therapy in Birmingham. The steady increase year by year was due to the fact that X-rays were coming to be recognised as a valuable method of treatment and Physicians and Orthopaedic Surgeons referred their cases in increasing numbers. Only 6 cases have been recorded for 1950, but this was because the survey ended in February of that year. The total number actually seen and treated in 1950 was 61 but 55 are not included in the present series.

Sex Incidence.

Of the total of 164 cases, 145 were men and 19 were women. This gives a sex incidence of roughly 8 males to 1 female and this ratio is in accord with most other writers. Fletcher however records an incidence of 36 males to 32 females in his series of 68 and at the other extreme Gwen Hilton had 60 males and only 2 females in her series of 62 cases.[22] [38]

The reasons for this disparity between the sexes is not apparent. The reasons put forward as offering possible explanations of the male prepondence are

(1) The greater liable to spinal trauma in the male sex.

(2) A higher incidence of focal sepsis, especially gonorrhoea.

Neither of these explanations however can be held to be valid because there is no evidence that they are the direct cause of the disease.

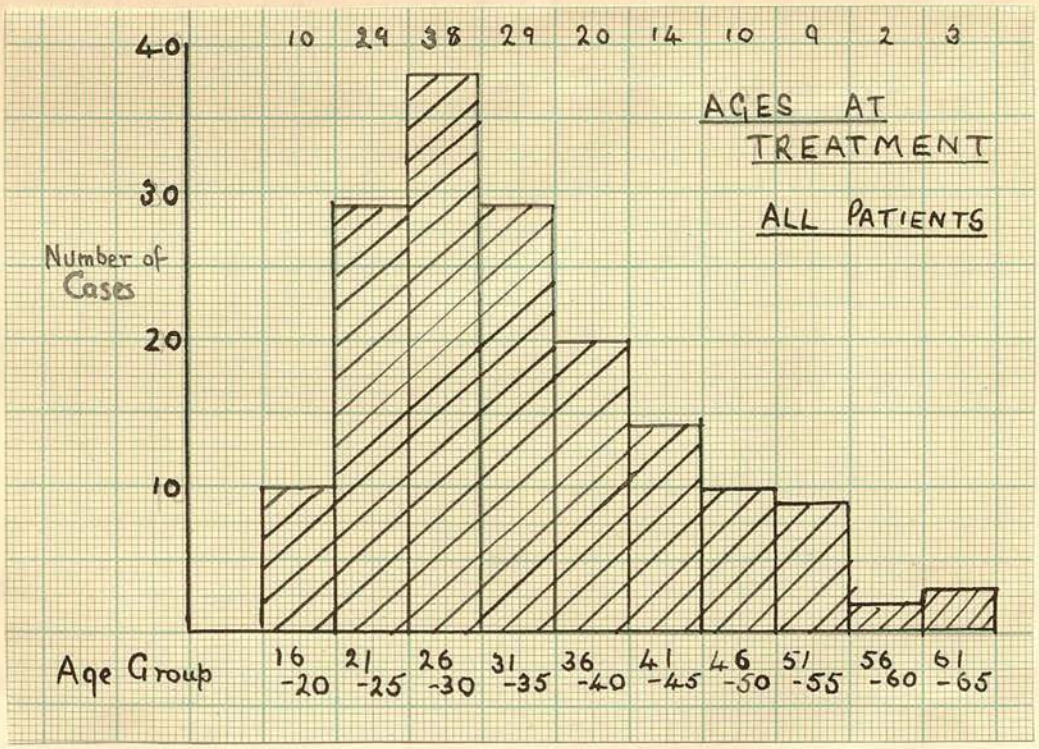
(3)/

(3) The possibility that the disease is inherited and its sex incidence follows certain genetic laws, if for example it was a sex-linked recessive. It would then be transmitted by females and manifest only by males. The evidence however that spondylitis or the tendency to spondylitis is inherited is not fully established (See later under Family History), and there is no evidence to suggest that any possible genetic abnormality is linked to the sex-chromosome.

(4) That the disease is due to an endocrine disturbance which is more liable to develop in the male sex. (See later under Aetiology: Endocrine Factors.)

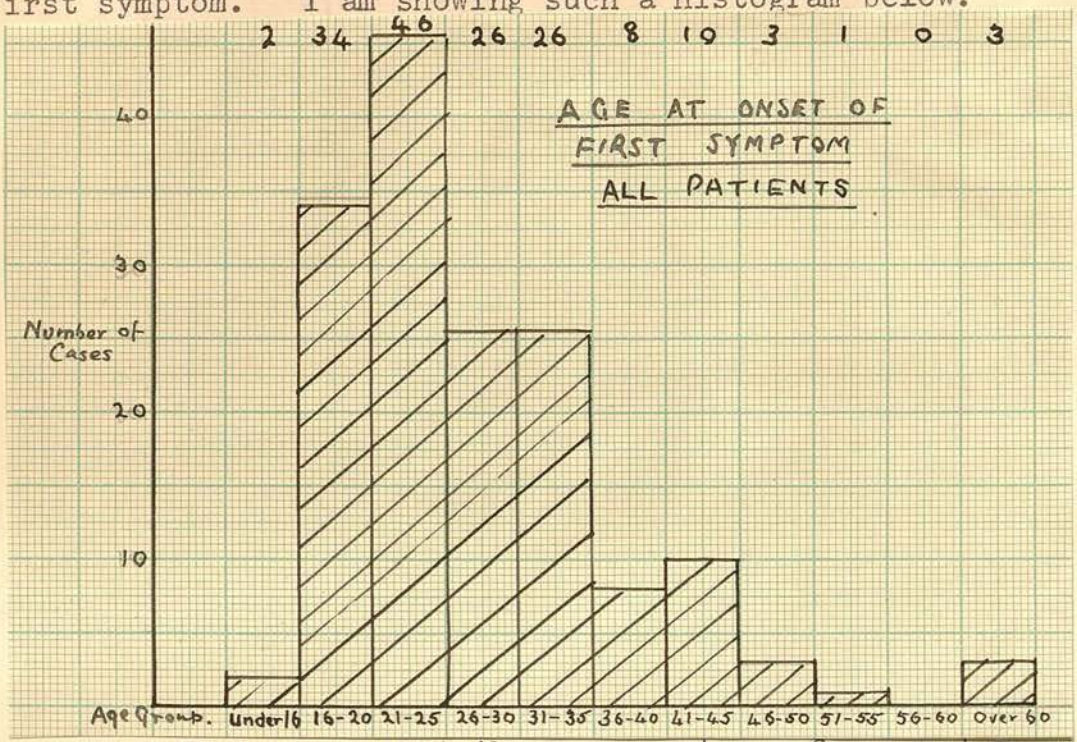
Age Incidence.

I am showing a histogram of the ages of the patients at the time they first came under my care and it shows that the greatest number of cases were between the ages of 26 and 30.



If the duration of the patient's symptoms is deducted

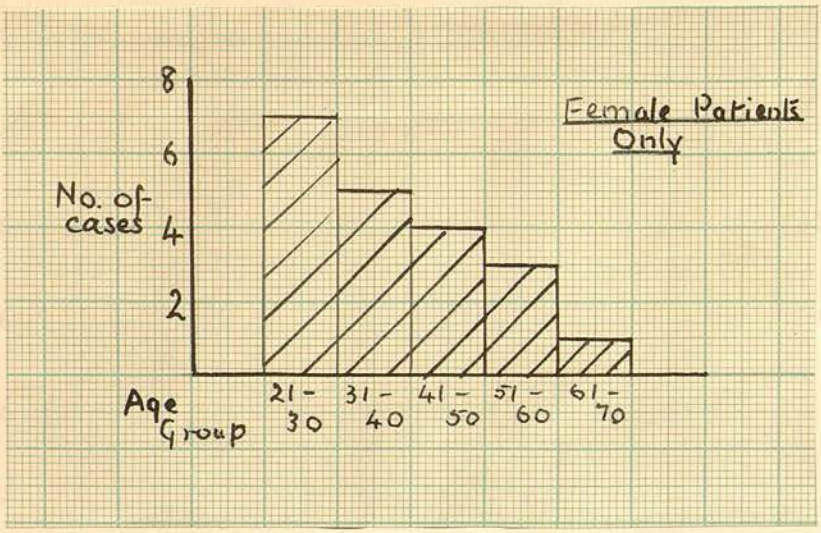
from each patient's age, a histogram can be built up showing the ages of the patients at the onset of the first symptom. I am showing such a histogram below.



It will be seen that the commonest age for symptoms to arise is between 21 and 25. In 108 out of the 164 (approximately two-thirds of the cases) the first symptom developed before the age of 30.

The number of female patients was relatively small. When their ages are grouped in ten-year periods the

greatest incidence also occurs in the decade 21-30.



AETIOLOGY.

Many causes have been suggested but no single factor has been proved to be entirely responsible. Other conditions are said to predispose to the disease or to precipitate it. In my survey I questioned each patient carefully regarding possible aetiological factors and especially with regard to 1. Focal sepsis 2. Gonococcal infection 3. Trauma 4. Previous exposure to shock or fatigue 5. Family history 6. Other rheumatic conditions.

1. Focal sepsis.

Two patients who came under my care had chronic sinusitis, one had heavily infected tonsils and several had carious teeth and periodontal infection. In the majority of cases however no gross septic focus was found. Where sepsis was present the septic foci

were treated before the spinal treatment was started. The two patients who had their sinuses treated, and many of the patients who had bad teeth extracted said that following the operation, their symptoms became worse for a few days and then improved. I assume that this temporary flare-up is due to a bacteriaemia following the operation and it would seem to suggest that a chronic septic focus present in the body could produce a temporary or occasional bacteriaemia with a similar aggravation of symptoms and increase in activity. It is for this reason that I think it advisable to treat any gross sepsis at an early stage.

While focal sepsis may be an aggravating factor such a focus was present in only a small proportion of the patients and I do not think it can be regarded as the direct cause of the disease.

2. Gonococcal infection.

Many of the older writers regarded ankylosing spondylitis as a manifestation of gonorrhoea. This view is mentioned many times in the French literature and it seems to date back to the original writings of Pierre Marie. All the cases he reported had chronic gonorrhoea and it was he who first considered that the gonococcus was the responsible agent.

I have questioned all my male cases and only six (4%) have admitted having had a gonococcal infection. Buckley also states that not more than 10% of his cases have suffered from this infection. While the evidence from patients on this point is not very reliable it seems doubtful if the incidence of gonorrhoea is any greater in this group of patients than it is in the general male population of the same age group. There is no doubt however that spinal joints may be affected

by a gonococcal arthritis - this however does not present the same clinical picture as ankylosing spondylitis.

3. Trauma.

As 87 out of my 164 cases were in the Services it is perhaps not surprising that many attributed their condition to injuries received on war service. 21 cases suffered a moderately severe injury about the time of onset of their symptoms. The injury was recorded if it was severe enough to confine the patient to bed for at least one day. Two of the injuries were obtained as the result of parachute jumps; four airmen had made forced landings, or had been thrown from their plane; and one naval rating blamed a fall which he had down a hatch.

My figures correspond fairly closely to those recorded by Buckley. In his series of 150 cases he

found a history of trauma in 17 and in 12 there was a clear and definite association of the injury with the stiffness. Taken together the figures suggest that the incidence of trauma in these patients was probably of some significance, and may be a factor in initiating the disease and perhaps also in increasing its activity.

4. Previous exposure to shock and fatigue.

6 patients attributed the onset of their condition to extreme exposrue during active service. 1 further patient blamed strenuous battle training and another 2 thought that the disease started when they were in damp billets. A Pole said that his symptoms began when he was confined in a concentration camp in Russia.

Although exposure to fatiguing conditions such as cited above are unlikely to cause the condition

per se, it seems likely that such experiences by lowering the patient's general resistance would tend to provoke and hasten the spread of the disease.

5. Family history.

All patients were questioned about the incidence of spondylitis in their relatives. In only 3 cases could a family history of spondylitis or spinal arthritis be obtained. In 1 of these cases the patient's father suffered from an ankylosed spine and in another he said that his father had had "rheumatism of the spine" and the description suggested that he had had ankylosing spondylitis. In the third case the mother had had spinal arthritis. In none of the cases was a history of spondylitis obtained in brothers or sisters.

Several writers however state that there is definite

evidence for a family incidence of the disease.

Rogoff and Freyberg[56] in a paper read before the American Rheumatism Association in 1948 estimated a family incidence in 9-13% of their 114 cases.

In a recent survey in this country, West studied 83 families of cases that had been treated in Bristol. He found 9 instances of multiple cases within 83 sibships - an incidence of 11%. He estimated that this figure is more than one hundred times greater than would be expected in a random distribution. However the number of cases seem to me to be rather small on which to make any definite conclusions regarding the family incidence.

The possible mode of inheritance has been studied, and Gates in his book on "Human Genetics" (1946) reviewed the literature on the subject. He concluded

that the disease was not inherited as a regular dominant or a simple recessive but that some other factor, environmental or genetic was required for its appearance.

6. Other Rheumatic conditions.

In taking the history I asked the patients about any previous rheumatic condition from which they may have suffered. 12 gave a history of having had rheumatic fever, or growing pains, or arthritis in childhood and in only 2 of these patients was there evidence of rheumatic heart damage.

In 4 of the cases the disease started as a polyarthritis involving the knees, hips, shoulders and small joints of the fingers and spread later to involve the spine. Although the spinal condition persisted the involvement of the other joints seemed to clear up

entirely.

Iritis: The association of iritis with spondylitis is recorded in most textbooks. Only 3 of my patients had a recent attack of iritis which required treatment. 1 of these patients suffered from a mild iritis when he first attended and after a few X-ray treatments the eye condition became much worse and the X-ray treatment had to be discontinued. Even after the spinal condition has been relieved there seems to be a tendency for the iritis to recur. This is a troublesome and distressing condition and sometimes takes some weeks to settle down. I have recently seen aureomycin used with considerable success in the treatment of such a case.

ENDOCRINE FACTORS.

I should like to discuss also the possible

influence of the endocrines as an aetiological factor.

Since the preponderance of the cases are in the male sex the influence of the sex glands would seem to be an important one. The fact also that the disease always begins in the sacro-iliac joints may point to a focus in the pelvic area. The prostate gland has been suspect but full proof is still lacking of the part it plays in causing the condition.

An interesting thesis concerning the sex incidence of the disease has been put forward by MacWhirter.[44] He drew attention to the fact that the disease in its early stage affects similar areas of the spine to the bony metastases in prostatic carcinoma. As the prostate gland elaborates acid phosphatase, he suggested that the changes which are seen in the spinal articulations in spondylitis, might be produced by a leakage of acid phosphatase to the

prostatic veins and carried to the sacro-iliac region and lumber spine by way of the paravertebral venous system described by Batson.[4] He investigated the acid phosphatase level in 7 patients and found a raised level in the cases in which the disease was in an early stage. Shorvon and Pearson (quoted in "Practitioner" Vol. 158 p. 418) reported a raised acid phosphatase in 1 early case out of several cases investigated. Other workers were unable to confirm these findings but this may be due to the different stage of the disease at which the phosphatase level was estimated.

Treatment based on the possibility of an increased acid phosphatase excretion by the prostate, on similar lines to the treatment of carcinoma of the prostate has been tried by giving small doses of stilboestrol. The results however have not been very encouraging.

In discussing the part played by hormones in causing this disease reference must be made to an article which appeared in the Journal of Clinical Endocrinology in March 1947 by Davison, Koets and Kuzell.[15] These workers made a study of the urinary ketosteroid excretion in patients suffering from rheumatoid arthritis and ankylosing spondylitis. The 17-ketosteroids are a group of substances which form the metabolic end-products of steroids originating in the adrenal cortex of both sexes and in the gonads of the male. Excretion in the normal male varies between 8 and 28 milligrams in 24 hours (average 14 milligrams). In normal females the limits are 5-18 milligrams with an average of 9-10.

In the author's series of 13 cases all were male and showed changes in the spine and hips. The excretion of 17-ketosteroids varied from 19.2 to 43.7

milligrams in 24 hours the average for the group being 27.3 milligrams. In the rheumatoid arthritis cases the range was from 3.5 to 21.6 milligrams - average 12.8 milligrams. The authors conclude that there is a trend towards greater excretion of 17-ketosteroids in ankylosing spondylitis whereas in rheumatoid arthritis it is not abnormal. Such a derangement in ketosteroid excretion suggests some adreno-cortical dysfunction. It should however be mentioned that a more recent article on ketosteroid excretion does not confirm the work of Davison et al. (See also Section on Recent Advances).

SYMPTOMATOLOGY.

In the majority of patients the history of the disease follows a general pattern. The onset is insidious, the earliest symptom complained of being pain across the lower part of the back, often radiating to the thighs. This pain is of a diffuse character and if the patient is asked to put his hand on the site of the pain he usually runs the back of his hand across the lower lumber and sacral region below the level of the iliac crests, but he is unable to localise it more accurately. Sometimes the pain is referred to the region of the buttocks and back of the thighs. It is more of an uncomfortable ache rather than a sharp stab and it is always worse after he has been at rest for a time. Patients frequently say that they have to

rise during the night or early morning and walk about to obtain relief. After sitting for any length of time they feel the pain worse, and a common complaint is, that they are unable to sit through the whole performance in a cinema.

Another characteristic feature of the pain is its remittance. In the early stages it may last for a few days and then go away for weeks or months. Each time it returns however it is slightly more severe than on the previous attack and it tends to last longer, till eventually it becomes constant. In the early stages the condition is usually regarded as muscular rheumatism or lumbago, and the symptoms may not be severe enough nor last long enough for the patient to consult a doctor. If a doctor is consulted at this stage a diagnosis of fibrositis is usually

made, and treatment with salicylates or counter-irritants brings complete relief. In the majority of cases however it is only when the patient finds that the simple treatment he adopted on previous occasions is no longer effective that he seeks his doctor's advice.

As the disease progresses to involve the lumbar spine the pain becomes more severe and its position can be more accurately defined. If he is now asked to localise its position he takes both hands and points to the paravertebral region of the lumbar spine over the erector spinae muscles which are usually in spasm. This pain may radiate round the trunk, into the groins, and also over the trochanteric regions to the outer aspect of the thighs. Occasionally stiffness rather than pain is the chief

complaint. This symptom, like the pain, tends to go away with exercise and return with rest. Sometimes the patients say that when they move about and especially when they go downstairs they experience twinges of backache at each step. This symptom is probably caused by the loss of elasticity of the intervertebral discs and the consequent loss of resilience in the affected part.

In patients first encountered at a later stage the pain may be most marked at a higher level of the spine e.g. in the dorsal-lumbar region or across the back in the interscapular region. When the dorsal spine is involved respiratory symptoms are commonly complained of. There may be shortness of breath or a feeling of tightness in the chest from the loss of respiratory movement, when the

costo-vertebral joints are involved and perhaps also from the dorsal kyphosis.

When the cervical spine is involved pain is usually complained of on either side of the neck, especially when an attempt is made to make any movement of the neck. In the later stages the patient is unable to look round without turning the whole body. When one comes to examine these patients whose only complaint is pain in the cervical region one also finds that there is complete rigidity of the entire spine, which apparently has undergone fusion without giving rise to any symptoms. There is no doubt that the disease can progress painlessly, because advanced cases are occasionally noted during radiological examination for some other complaint and apparently without giving any symptoms

previously. Should the hip joint become involved a limp soon develops and pain is felt in the groin and over the trochanteric region. Pain radiating down the inner side of the thigh is also present and associated with spasm in the adductor muscles.

The amount of systemic upset is variable. In about half the cases the general health does not seem to be affected. In the others there is a varying degree of systemic disturbance, with tiredness anorexia and loss of weight. This however is usually noted when the disease is of short duration and rapid progress.

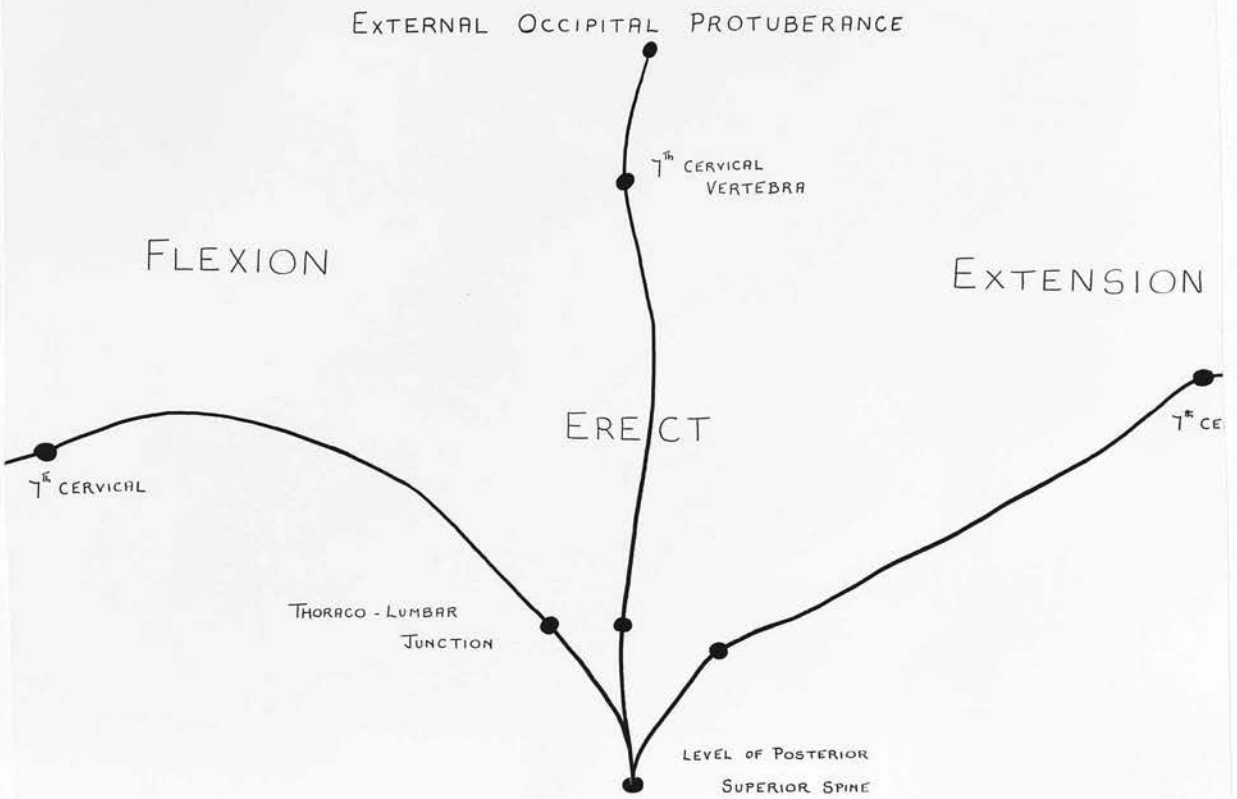
PHYSICAL SIGNS.

In the early case where the sacro-iliac joints only are involved there may be very few physical signs. Neither the patient's posture nor his gait are affected and the only abnormality which can be detected is tenderness over the sacro-iliac joints posteriorily. Pressing the iliac bones together does not usually elicit pain but it may be produced by flexing both thighs with the legs straight. Some slight limitation of movement may also be present in the lower lumbar spine.

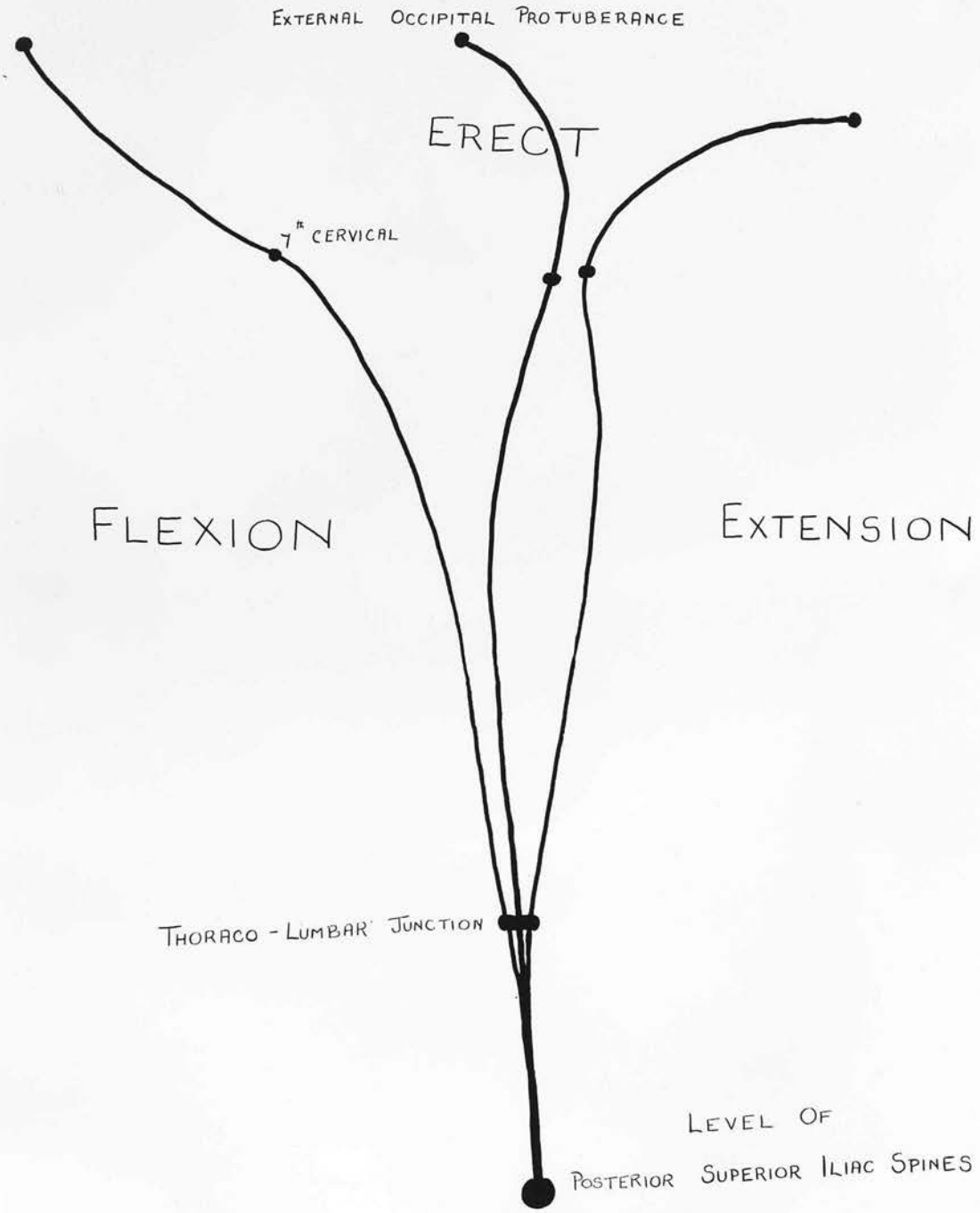
To try and measure spinal movement and make a record for comparison later, I use strips of lead ($\frac{3}{4}$" x $\frac{1}{4}$" on cross-section and 30" long) covered with rubber or polyvinyl plastic. One strip is pressed against the back during full flexion and the other

during full extension. By comparing the strips it is possible to assess the amount of movement which takes place at the various levels of the spine. A tracing can also be made from the lead strips and used as a record. By this method it is possible to determine whether spinal movement is increasing under treatment or/is becoming rigid.

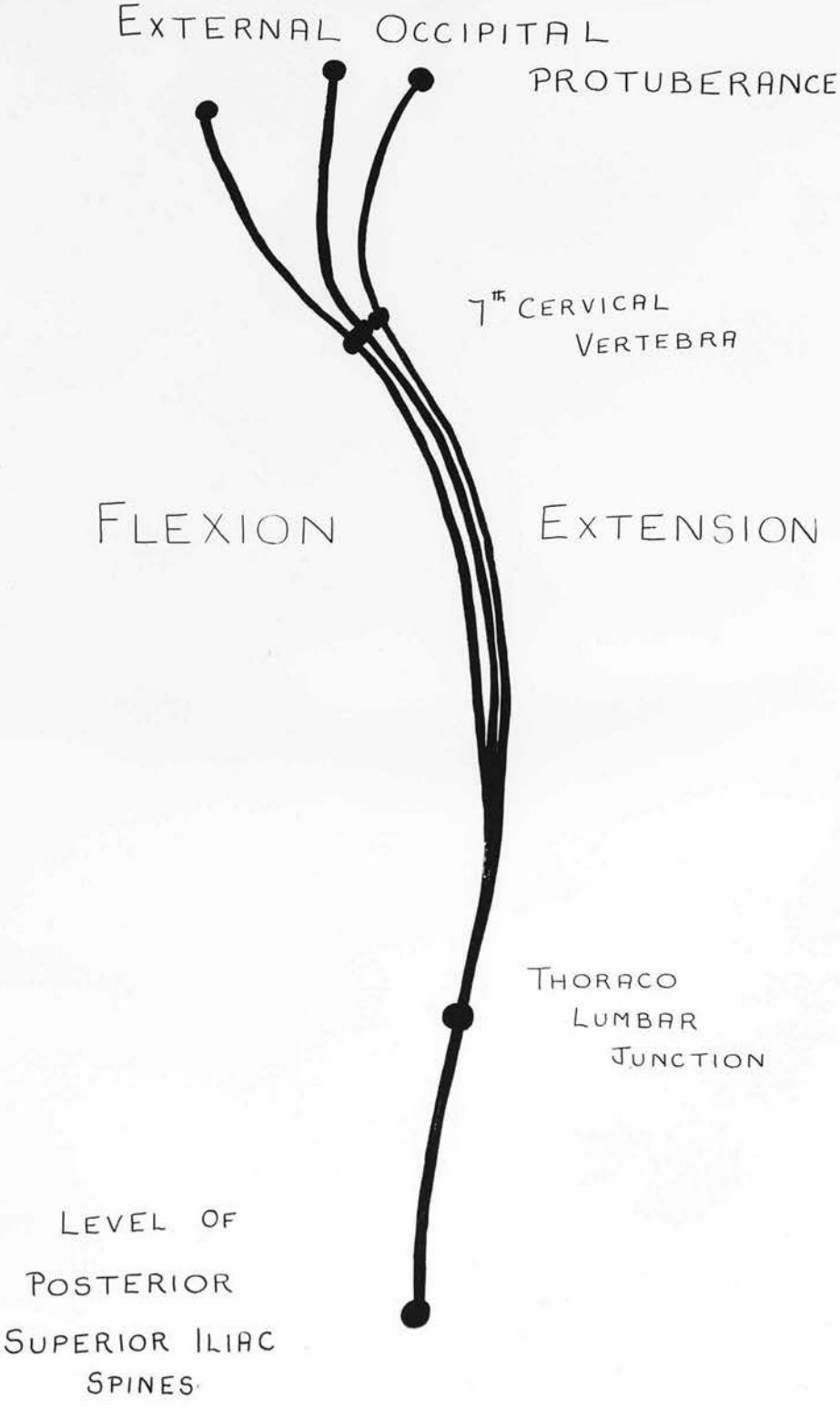
the spine



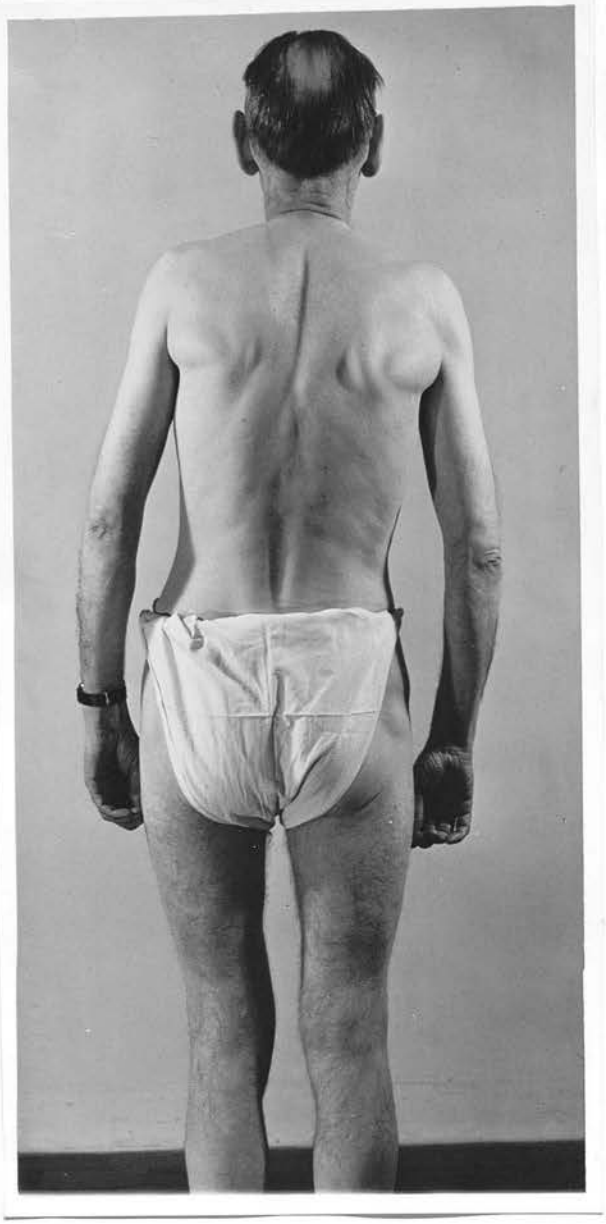
Tracing showing the range of spinal movement in the normal subject. The tracing has been made by pressing a strip of lead against the patient's spine in the erect posture and in full flexion and extension. A tracing was then made from the lead and this was photographed.



Similar tracing of a patient who suffers from ankylosing spondylitis. During flexion and extension there is no movement of the lumbar section of the spine. Dorsal spine movement is still present but is limited. The cervical spine moves normally.



Tracing taken from a patient who has advanced spondylitis. There is practically no movement of the dorsal or lumbar spine during flexion and extension. Some cervical movement is still present but it is limited.

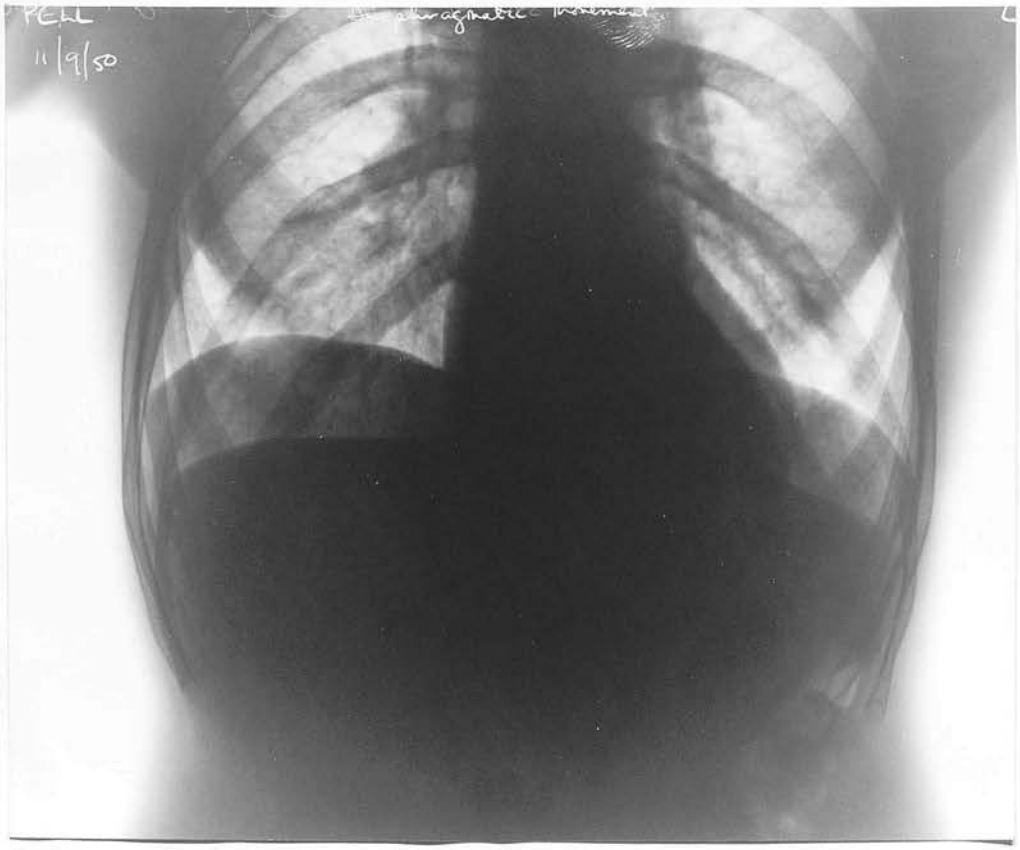


Lumbar spine involvement showing spasm of erector-spinae muscles.

When the lumber spine is involved spasm of the erector spinae muscles develops and the muscles become prominent and stand out as two hard bands alongside the lumbar spines. On palpation the muscles are very hard and may be tender. During flexion-extension movements of the whole spine the lumbar section remains rigid. At a later stage when the disease has progressed to ankylosis of the lumbar vertebrae, the muscles waste, the normal lumbar curve is lost and the spine in this region becomes flat.

By the time the dorsal spine is involved the lumbar region is already rigid. Dorsal movement is lost and in the untreated case a gradual kyphosis develops from loss of muscle tone. The costo-vertebral joints are involved about the same time as the dorsal articulations and there is gradual limitation of

Normal patient. Photograph of chest in inspiration and expiration with the two exposures superimposed. Note the outward movement of the thoracic cage in inspirati with comparatively little diaphragmatic movement.



The same double exposure taken in a patient with ankylosing spondylitis who had involvement of the costo-vertebral joints. There is very little thoracic movement but an increased range of diaphragmatic movement.

respiratory movement. As the intercostal movement becomes more and more limited the patient tends to develop an abdominal type of breathing with increasing diaphragmatic excursion.

As already mentioned when there is early cervical spine involvement the patient complains of pain in the cervical muscles on moving the head, and neck movements become increasingly stiff. At this stage there is usually limitation of lateral flexion of the neck and this movement is usually markedly restricted before the other cervical movements become affected. In the later stages however flexion, extension, and rotation are restricted. Because of the dorsal kyphosis and forward stoop the neck is held in a hyperextended position and tends to become fixed in this position.

The hip joints become involved at an advanced stage of the disease - usually when the spine is already rigid. The first movement to be limited is external rotation followed by limitation of abduction. Flexion and

1.

2.

3.

Typical profile views of advanced cases, showing dorsal kyphosis with hyperextension of the neck. In the third case the hips are also involved and a flexion-contracture deformity is developing.

extension movements are usually retained till later and do not become affected till there is more marked involvement of the joint. In early hip involvement the patient walks with a slight limp tending to throw his weight on the opposite limb as much as possible because of the pain he experiences when his weight is borne on the affected side. In the late stages of hip involvement, a flexion-adduction contracture develops with some apparent shortening of the limb. To compensate for the shortening the patient now walks on his toes with the foot flexed in the equinus position. With bilateral hip involvement walking becomes increasingly difficult and the patient tends to walk in small steps using the knee joints only. Usually at this advanced stage the knee joints are also affected and he is confined to bed. A few of my patients however have managed to get about by

swinging on two crutches.

RADIOLOGICAL FINDINGS.

By the time the disease has been suspected clinically there is evidence of radiological involvement. In talks I have had with several orthopaedic surgeons they have mentioned that frequently they have seen cases in which they have been able to make a diagnosis of spondylitis before radiological signs develop, but who later showed X-ray changes in the joints. I cannot say that I have seen such a case but this may be due to the fact that many cases referred to me have been under treatment or observation for some time, and I am less likely to see the patients at an early stage than the orthopaedic surgeon. I should think however that early clinical findings probably precede the X-ray signs (and a diagnosis may be possible

at this stage) because in an established case of lower spinal involvement one frequently observes signs of involvement of the upper part of the spine without much radiographic change. One is hesitant of hazarding a diagnosis of ankylosing spondylitis however without X-ray confirmation, unless one is experienced in seeing many cases of the disease.

The first radiographic signs of the disease develop in the sacro-iliac joints and the changes are usually symmetrical. Juxta-articular areas of erosion cause absorption of the bone, and the joint margin instead of being sharply defined, becomes ragged and presents a motheaten appearance. The ilium seems to be more readily affected in the early stage than the sacrum. This process, which starts in the lower part of the joint spreads to involve the

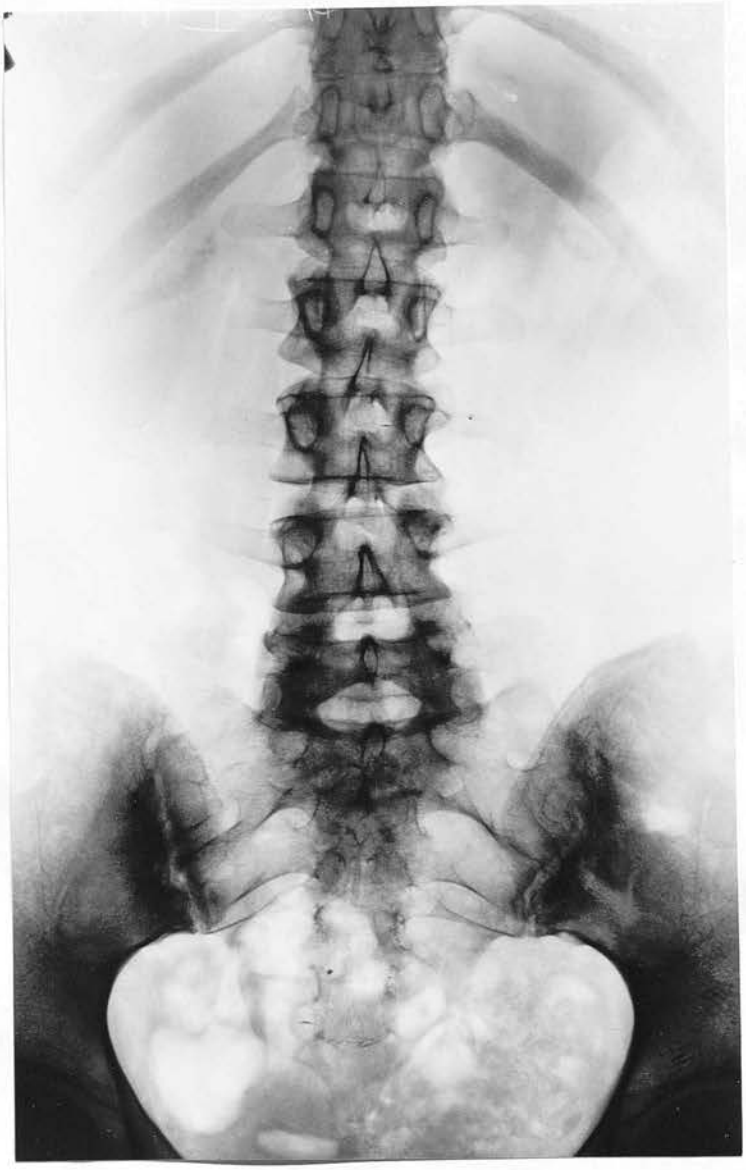
View of sacro-iliac joints showing irregularity of the joint line with bone sclerosis The disease appears to be more marked in the lower part of the joint.

View of pelvis showing sacro-iliac joint involvement. The joint line is irregular and in the juxta-articular region there are areas of erosion with bone sclerosis.

entire joint line. The joint space which in the early stage appears wider than normal later loses its definition and becomes completely obliterated. The bones in the region of the joint show sclerosis, but in contrast to this sclerotic area the general density of the bones is less than normal. In the terminal stage bone trabeculation becomes continuous across the joint and complete ankylosis develops.

Occasionally in the early case the disease appears unilateral but this is uncommon and I have only seen two such cases.

Generally speaking the disease progresses in a caudo-cephalic direction. Sometimes however a small section of the spine seems to be by-passed for a time and then becomes involved later.



View of sacro-iliac joints and lumbar spine. The sacro-iliac joints are involved and there is also involvement of the posterior spinal articulations.

Lateral view of lumbar spine. The normal lumbar curve is lost and the spine appears straight. The vertebral bodies have lost the normal concave anterior border and present the square "brick-like" appearance.

In the lumbar spine the vertebral bodies develop a square brick-like appearance as seen in the lateral view, the normal concave anterior border becoming straight. This is regarded as one of the early signs of lumbar spine involvement and is probably due to changes in the region of the anterior longitudinal ligament. Involvement of the posterior articulations is difficult to define in the early stages. The joint usually lies in an oblique plane and it may be necessary to rotate the patient to obtain a film which demonstrates the joint line. Here also the articular margins become irregular and the joint line gradually disappears until the bones eventually fuse. At a later stage calcification and ossification develop in the intervertebral ligaments. At first this process is localised to one or two areas but later the whole spine is involved producing the classical

X-ray picture of the"bamboo spine".

Dorsal spine involvement also manifests itself by squaring of the vertebral bodies in the early stages. Later, the posterior articulations fuse, but this change is a difficult one to demonstrate radiologically and again, oblique views may be necessary to define the joints. The costo-transverse joints and costo-vertebral joints are usually involved at the same time as the dorsal spine and slowly become ankylosed. These changes can sometimes be seen in a posterior view of the dorsal spine.

Radiological involvement of the cervical region develops later than the clinical signs. By the time the cervical articulations show X-ray changes, the limitation of movement is extreme and the neck may be completely rigid. As in the other areas the posterior

Lateral view of the cervical spine. The posterior spinal articulations are obliterated and the joints are fusing. There is some calcification anteriorly between the second and third cervical vertebrae.

spinal articulations lose their sharp definition and the bones gradually fuse. Intervertebral ossification develops and is particularly well seen in the lateral view.

In the hip joint also, the X-ray changes come on after the clinical signs, and only when there is gross clinical involvement does the X-ray film show much change. As in the sacro-iliacs, areas of bone erosion develop in the region of the joint line which gradually loses its clear definition. There is some bone sclerosis and later when the joint is completely destroyed continuous bone trabeculation can be seen between the acetabulum and head of the femur.

With the local change in the joints the adjoining bones show rarefaction and in the advanced cases this change may be extreme. So much so, that some writers

Symphysis pubis involvement - Early stage showing irregular joint line with sclerosis of adjacent bone.

Symphysis pubis involvement - Late stage showing fusion of the bones.

have suggested that the disease is a parathyroid disturbance with an upset in the calcium-phosphorus metabolism. An examination of the blood chemistry does not confirm this thesis however.

Symphysis pubis involvement:

In some cases of moderately advanced disease the symphysis pubis shows the same changes that have been noted in the other joints. There is subarticular erosion with adjacent bone sclerosis and loss of the sharply defined straight joint line. New bone can be seen forming in the space between the two pubic bones and there is gradual progress towards complete fusion. I am showing radiographs of some of the patients who have had this disease. Out of 19 females who suffered from

spondylitis I noted this change in 5. In the 145 males however it was present in only 2 cases. This seems to indicate that the involvement of this joint occurs relatively more often in the female than in the male. In 2 of my female patients definite symptoms were produced by the involvement of this joint. In 1 case the patient had pain and discomfort in the suprapubic region. In the other case the principal symptom was dyspareunia. I treated both cases with X-ray therapy directed to the symphysis and in the same dose as I give the spine, and both patients obtained complete relief.

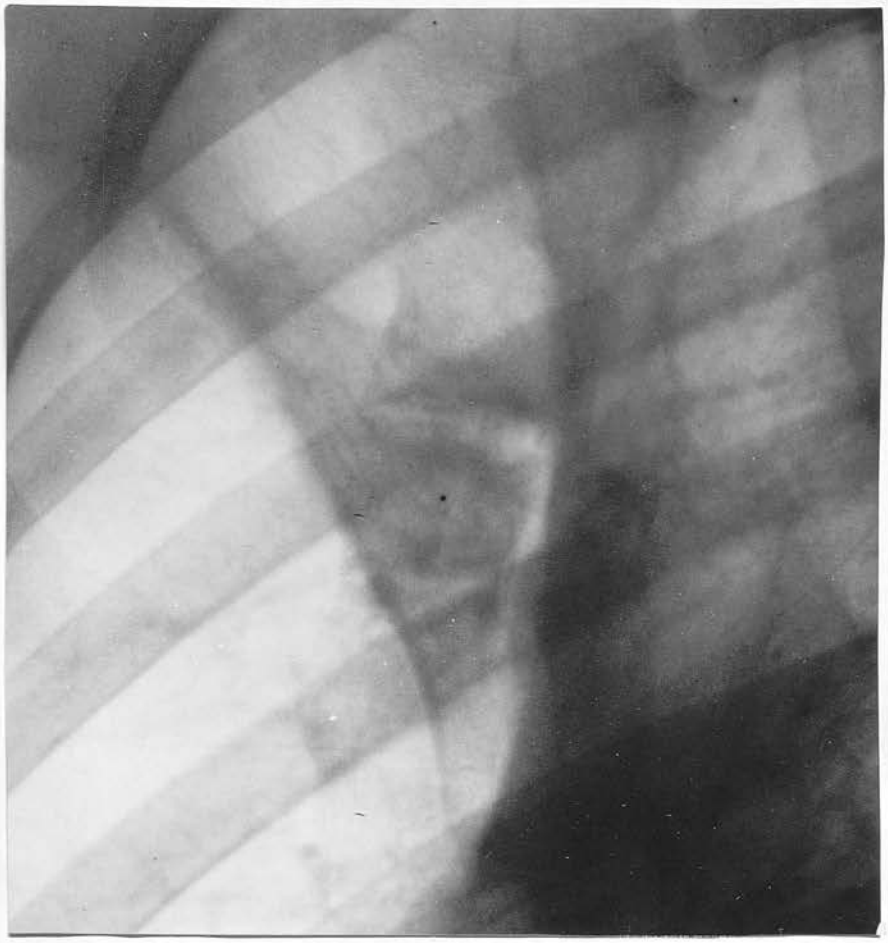
It appears that this joint is not involved until after the sacro-iliacs have fused. When this occurs the pelvic ring is fixed and there is no longer any need for a movable symphysis. Its fusion gives a much

X-ray photograph showing changes in the ischial tuberosities in a case of ankylosing spondylitis.

X-ray photograph showing the same changes in another patient. Both patients complained of pain on sitting and the ischial tuberosity region was tender to palpation.

stronger pelvic ring but should these women become pregnant this fixed bony ring would undoubtedly cause difficulty. I am keeping the female patients who have had symphysis involvement under observation but so far none of them has become pregnant.

A further radiological appearance worthy of comment is the change one sees occasionally at certain points of muscle attachment. In particular, these changes can be seen on the ischial tuberosities at the origin of the hamstring muscles and along the iliac crests. In these situations one may see small areas of bone erosion similar to the changes seen in the region of the sacro-iliac joints. The cortex of the bone becomes irregular and ragged and osteophytic outgrowths may be seen at the point of



Oblique and lateral views showing the X-ray changes in the manubrio-sternal articulation - as noted by MacWhirter.

muscle attachment. These radiological changes are sometimes associated with local pain. It is not uncommon for patients to complain of pain in the ischial tuberosity region, or over the anterior superior iliac spine at the origin of the sartorius muscle or occasionally at the greater trochanter where the gluteal muscles are inserted. In these situations also local X-ray therapy may relieve the pain although I have also found histamine ionisation to be equally beneficial.

Another articulation occasionally affected is the articulation between the manubrium and body of the sternum. MacWhirter recorded Radiological changes at this joint and I am showing X-rays of one of my patients who complained of pain and tenderness over the sternal angle

HAEMATOLOGICAL AND BIOCHEMICAL EXAMINATIONS.

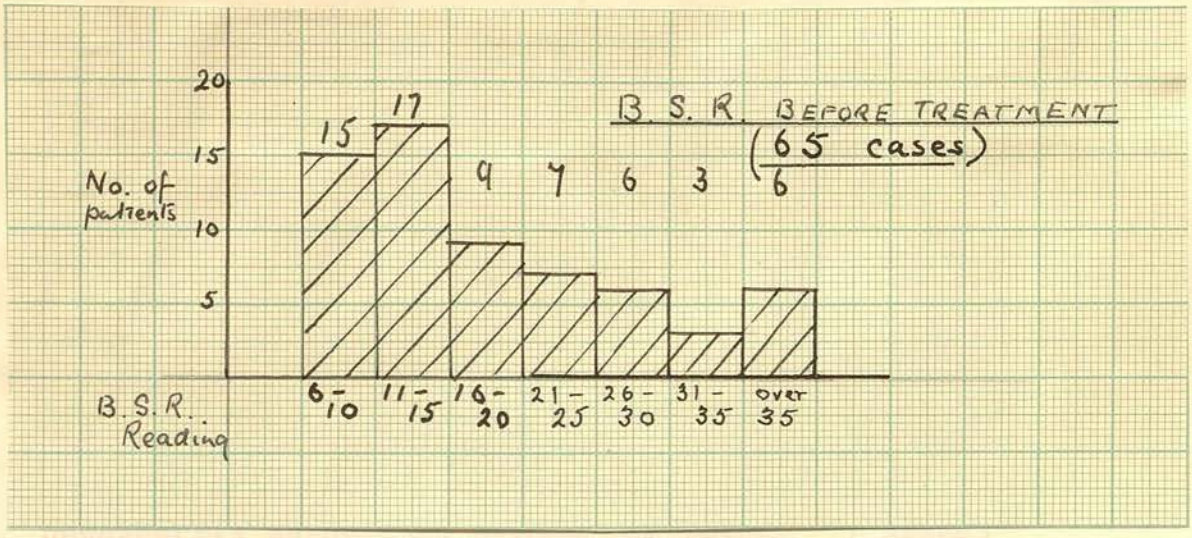
Blood Count:

In many of the earlier cases I had a full blood examination carried out. Most of the counts were within the limits of normal. A few of the patients however showed a slight anaemia of the hypochromic microcytic type. No abnormality was noted in the white blood cells or in the differential white cell count.

Blood Sedimentation Rate:

The blood sedimentation rate was measured before treatment in most of the cases and follow-up estimations were also recorded in a selected few cases to try and find the value of this estimation in assessing prognosis, and trying to determine the activity of the disease.

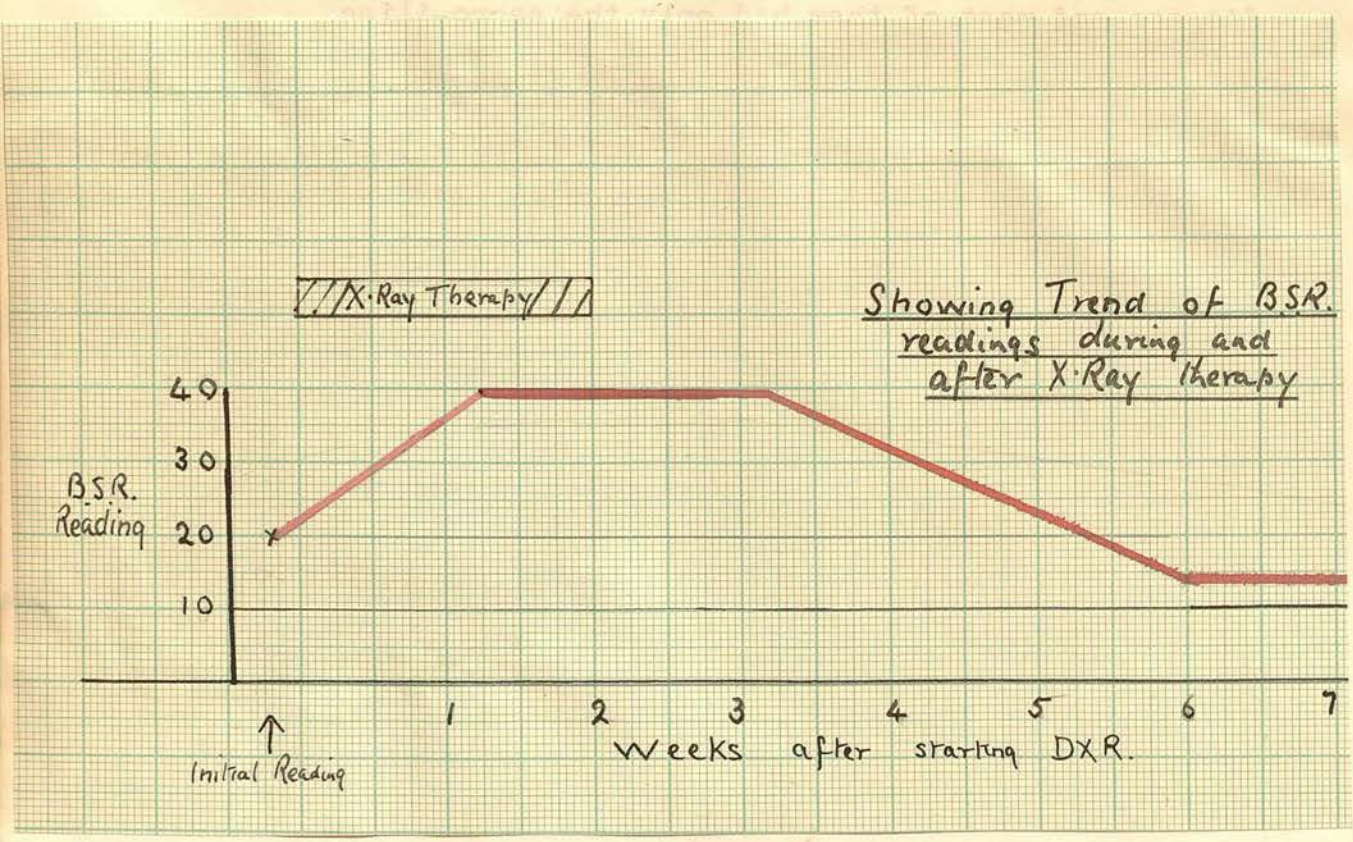
The Wintrobe method was used for all the estimations and a normal reading taken as 0-10 mm per hour for a man and 0-20 mm per hour for a woman. In 65 male cases that were seen before treatment there was a very considerable variation in the reading obtained. I am showing below a histogram of the readings.



From this it can be seen that 15 out of the 65 cases were within the normal range and in the remaining 50 the reading was raised. In the 15 cases who showed a normal reading I reviewed their notes to try and find any point which they might have had in common. I

tried to find if there was any correlation with the patient's age, or with the extent of involvement of the disease, or with the duration of the symptoms. There did not appear to be any association with either the age, or the duration of the symptoms and the B.S.R. level. With regard to the extent of involvement of the disease however I got the impression that the cases which had a low sedimentation rate showed only early disease and most of them had only the sacro-iliac joints or the sacro-iliac joints and the lumbar spine involved. On the other hand early disease is not necessarily associated with a low B.S.R. I assume that the low B.S.R. indicated early disease with a low activity, and nearly all these patients became symptom-free and apparently cured after they were treated.

As already mentioned 50 male patients had a raised


X-Ray Therapy
Showing Trend of B.S.R. readings during and after X-Ray therapy
B.S.R. Reading
40
30
20
10
1
2
3
4
5
6
7
Initial Reading
Weeks after starting DXR.

sedimentation rate when seen first. Although this estimation is extremely erratic and liable to be influenced by many factors, I think that the extent to which the sedimentation rate is increased indicates roughly the degree of activity of the disease. The highest readings were obtained in those cases in which the whole spine appeared to be affected simultaneously - sometimes called rheumatic spondylitis.

In a few cases I estimated the sedimentation rate daily during the treatment. In every case the rate gradually increased during the first week and remained at a high level. This is the effect of X-radiation given for any disease and the rise is not specific for ankylosing spondylitis. After completing the X-ray treatment the sedimentation rate falls, but the fall is delayed for one to two weeks. In 13

cases I compared the B.S.R. two weeks after treatment with the pre-treatment level. In 7 cases it was raised and in 6 it was lowered; on average the readings were about the same as before the treatment started.

One month after completing the X-ray treatment more than two-thirds of the cases had a lower B.S.R. than before they started, and six months after treatment three-quarters of the cases had a lower B.S.R.

A further B.S.R. estimation made two years after the treatment still showed that about three-quarters of the patients had a lower B.S.R. than originally. Very few however came down to a normal level even after two years.

There did not seem to be much connection between

the sedimentation rate and the symptomatic improvement and no definite correlation could be found.

In summarising I think one can say;

1. In over three-quarters of the cases of ankylosing spondylitis the blood sedimentation rate is raised.
2. In the few cases in which the B.S.R. is not raised the disease is usually in an early stage and not of a very active type.
3. With X-ray therapy the B.S.R. rises during the treatment but later falls.
4. Follow-up estimations show that this fall goes on for a long period of time gradually and settles at a lower level than formerly. Very few return to normal.
5. The fall in B.S.R. is associated with symptomatic improvement but a subsequent rise does not necessarily

indicate a flare-up in symptoms, nor is a recurrence in the patient's symptoms always associated with a raised B.S.R. although this is sometimes noted.

In conclusion I doubt if the B.S.R. estimation is of much value in prognosis. A high rate appears to be associated with an active and progressive condition but a moderately raised rate of sedimentation may still be present when the patient is symptom-free and the disease apparently quiescent.

Vital Capacity

I measured the vital capacity of the lungs in 10 male patients who had involvement of the dorsal spine. The readings obtained were 2850, 3050, 2100, 2750, 2420, 2300, 2200, 2000, 2500, 2700 c.c. All these readings were below the normal for patients of their age.

On 5 of these patients the vital capacity was estimated after X-ray treatment, and the results were:-

Before	After	Difference
3050	3300	plus 250
2100	2200	100
2420	3000	580
2300	2550	250
2500	2800	300

In each case the vital capacity after the X-ray treatment (no physiotherapy being given) was slightly greater than before. The estimation of vital capacity is not a very reliable one, but the improvement is probably due to increased mobility

of the costo-vertebral articulations allowing a greater chest expansion.

Blood Calcium and Phosphorus

In 6 of my early cases I estimated the levels of calcium and phosphorus in the blood, but all the estimations were within the range of normal.

TREATMENT:

I propose to discuss the treatment under three main headings:-

A. General Medical Treatment.

B. X-Ray Treatment.

C. Orthopaedic Treatment.

A. General Medical Treatment.

In the early case where there is no spinal deformity the aim of treatment is the relief of symptoms, the prevention of deformity and the restoration of as much movement as possible. As already mentioned the blood sedimentation rate is raised in most of the cases indicating that an infective or metabolic process is active. It is therefore important that the patient should be allowed a certain amount of rest.

In the early case it is unnecessary and undesirable to keep him in bed for the whole of the day and he need not be admitted to hospital. I usually advise the patients to rest and relax for a few hours of the day, preferably during the afternoon. For resting and sleeping, a firm mattress should be used with fracture boards inserted beneath the mattress to prevent sagging. If there is no deformity in the dorsal or cervical regions he should have only one pillow. In the beginning the patients usually complain that the hard mattress and low pillow are uncomfortable, but after a few days they become accustomed to them and soon prefer them to a soft bed with a high pillow, which tend to produce a dorsal kyphosis. I consider this arrangement of the bed as one of the important points in the nursing of this condition and in the prevention of spinal deformity.

Although a few hours rest should be allowed each day, I think it is unwise to immobilise completely in a plaster shell a patient who has involvement of the dorsal or lumbar spine but in whom the back is not yet completely rigid. If one does immobilise such a patient one finds that when the plaster is removed after two or three months the spine is always quite rigid and no amount of subsequent treatment can do anything to mobilise it. I consider therefore that complete immobilisation should be avoided and I encourage all my patients to practise spinal exercises and respiratory movements from the time they come under treatment (See later under Physiotherapy).

Under the heading of General Treatment an attempt should be made to improve the patient's general health and vitality. As pain is usually a leading symptom and one which undermines the general well-being it is

important that analgesic drugs should be administered in sufficient doses to control the pain. In the majority of cases X-ray therapy relieves pain within a few days or a week but until it takes effect, the patient should be given analgesics and sedatives to make him comfortable in his hard bed and allow him to sleep. Aspirin or calcium aspirin can be given in doses of 10-15 grains thrice daily - one dose being given last thing at night and combined if necessary for a few nights with phenobarbitone. As an alternative Tab. codein co. may be used and given in doses of 10 grains thrice daily. It is usually unnecessary to continue the drugs for longer than one week because X-ray therapy, once started, rapidly brings relief of pain and stiffness.

As already mentioned there is a hypochromic anaemia in some cases and when this is present iron should be

prescribed. Other measures taken to improve the patient's general condition and his lowered body vitality include strychnine tonics, vitamins and ultra-violet light (see under physiotherapy). Some people have recommended the use of calcium preparations when there is radiographic evidence of bone decalcification but these are of doubtful value.

Septic Foci:

As has been previously mentioned under aetiology there is little evidence that foci of sepsis are the direct cause of the disease and the previously held view that the gonococcus is the responsible organism is no longer held. On the other hand, however, septic foci do seem to aggravate the symptoms and possibly accelerate its rate of progress. For this reason any evidence of sepsis should be dealt with as soon as possible. The teeth and tonsils should be inspected

and treatment instituted if necessary. If the patient gives a history of repeated attacks of tonsillitis or sinusitis the advice of an oto-laryngologist should be sought. Frequently extraction of teeth causes an increase in the patient's pain which lasts for a few days. This is probably due to a temporary bacteriaemia and if many teeth require to be removed it is probably better to perform the operation in several stages to prevent this post-operative flare-up. Some people also advocate the use of penicillin and sulphonamides before any operation for focal sepsis is undertaken.

B. X-Ray Treatment.

It is difficult to offer a satisfactory theoretical explanation for the action of X-rays in ankylosing spondylitis. The action of various radiations in inflammatory conditions in general has not been studied histologically to the same extent as in malignant disease. Although X-rays are extremely effective in the treatment of many inflammatory conditions the mode of their action is largely hypothetical and I can only speculate on the possible ways in which they may bring about their effect.

1. One of the effects of X-radiation on tissue is the effect produced on the blood vessels. This can be seen on the skin and on the mucous membrane in any patient undergoing treatment with moderate doses. When one observes the skin or mucous membrane a short

time after the exposure there is a definite red patch (erythema) due to a dilatation of the capillaries. Thus in a recent article on experimental skin erythema by Miss M. C. Tod a skin erythema appeared within twenty-four hours in 70% of cases treated with doses of 200r and doses of 450r produced a reaction on all subjects treated. The higher the dose the greater the erythema which in most cases lasted six to eight weeks. This reaction can also be seen on the mucous membrane and I think it can be reasonably assumed that a similar erythema and capillary dilatation takes place in all the tissues subjected to the radiation. With the doses employed in the treatment of spondylitis vascular dilatation must take place in the tissues affected by the disease and around the spinal articulations. This dilatation may provide a mechanism by which the

inflammatory exudate is increased and there is also an increase in the local antibody formation. An increased blood flow throughout the area may also hasten the removal of deleterious toxic products. This local hyperaemia around the affected joints may also help to relieve local pain and reduce muscle spasm in the same way as the hyperaemia produced by short wave diathermy. A further effect of the X-rays which may influence the limitation of movement is the action which they have on young newly formed fibrous tissue. In this condition of spondylitis in which young fibrous tissue proliferates around the spinal joints and beneath the articular cartilages the X-rays may act in the same way as they do on a newly formed keloid scar and arrest or reduce this proliferating tissue.

Although these theories may explain some of the

action of the X-rays there must also be some additional effect which makes X-ray therapy almost a specific remedy for this type of arthritis because in rheumatoid arthritis which is pathologically similar to ankylosing spondylitis X-rays do not produce the striking or permanent improvement seen in the spondylitic. The action of the X-rays therefore cannot be attributed to the effect on the blood vessels and fibrous tissue only.

Some writers (Ellis, Jolles) have suggested that X-ray therapy releases a diffusible substance in the tissues irradiated and that this substance exerts some action in arresting the progress of the disease. This however is rather a nebulous theory as neither the nature of the diffusible substance nor the manner in which it acts are stated.

DURATION OF SYMPTOMS BEFORE TREATMENT

AREA INVOLVED

Sacro-iliac joints only	2.5 years
Sacro-iliacs and lumbar spine	4.8 years
Sacro-iliacs, lumbar and dorsal spine	5.4 years
Sacro-iliacs and whole spine	7.8 years
Spine with other joints	8.3 years
Average for all cases	5.9 years

Indications for X-ray Treatment.

With a few exceptions I consider that every case of spondylitis should have the benefit of X-ray treatment. As I shall show the improvement to be expected from this form of treatment is so very much greater and lasting than with any other form of treatment that I think it should be given first and at the earliest opportunity. Too often one sees patients who have had prolonged immobilisation and long courses of physiotherapy before treatment by X-rays have been considered and probably the X-rays have been given as a last resort when the spine has become ankylosed. Figure opposite gives the duration of the patient's symptoms when he first attended for X-ray treatment and relates this to the extent of the disease. From the figure it will be seen that when

the sacro-iliacs only were involved the symptoms had been present 2½ years on an average. When the lumbar spine also was involved there was a history dating back 4.8 years and in the more advanced cases a history of 7.8 years was obtained. I think it is unfortunate that such long periods should elapse before the patients receive the benefit of the X-ray treatment, because in the early stage when only sacro-iliac joints, or sacro-iliacs and lumbar spine are involved this treatment can relieve symptoms and, I believe, arrest the disease.

Out of my 164 cases, 111 had had previous treatment lasting in some instances for years. I questioned all my patients and found that

59 had courses of infra-red or heat
23 had short wave diathermy
62 had massage and exercises
41 had immobilisation in plaster
31 had spa treatment

before being considered for treatment by X-rays. Heat and short-wave diathermy nearly always produced a temporary improvement but after a few days or weeks the symptoms returned. Massage and spa treatment did not appear to give much relief.

Some of the patients had these treatments because they lived in a remote part of the country or were on active service where facilities for obtaining X-ray treatment were not available. I now recommend and urge that all cases are referred for this treatment at the earliest opportunity and that it is given even before orthopaedic measures are undertaken. If the patients happen to be attending a hospital where X-ray

therapy facilities are not available transfer to a radiotherapy centre should be arranged at the earliest opportunity.

As already mentioned there are a few exceptional cases in which X-ray therapy should not be given or should not be given immediately. Where the spine is completely rigid and painless and radiography shows bony ankylosis there is nothing to be gained by any form of treatment. In many cases, however, one section of the spine may be rigid and ankylosed while another may still have limited movement. In such cases I treat the whole length of the spine in the hope that I may be able to arrest the disease as well as relieve the symptoms.

In the group of cases in which the disease starts acutely as a polyarthritis I think it is advisable to

delay treatment by X-rays for a few weeks till the temperature settles down and the disease is less active.

X-ray technique:

I have used several techniques including

(1) Wide field irradiation

(2) Localised radiation to the spine over a short overall time

(3) Localised radiation to the spine over a long overall time

(1) Wide field irradiation:-

This method of treatment was popular for a few years around 1940 mainly on account of the writings of Gilbert Scott. In this method the whole trunk of the body is exposed to small doses of X-ray. The total dose which may be given is limited by the effect of the X-rays on the haematopoetic tissue (in particular the white blood cells and the platelets) and is a comparatively small one. Scott rationalises this method of treatment by saying that spondylitis is

primarily a constitutional disturbance, and he asserted that carefully controlled doses of medium voltage X-rays given to the whole trunk raised the resistance of the whole organism, and brought about an improvement in general health and weight and probably also relieved symptoms. He used a kilovoltage of 100 with a filtration of 3 millimetres of aluminium and a dose of 60-100r were given to the whole trunk once or twice a week for several weeks. Over a period of five years he treated over 200 cases and although no definite results are recorded the author regarded them as "remarkable".

I have seen many cases treated by this method of wide-field irradiation when I worked in Professor MacWhirter's clinic and a few of the present series have been treated by this technique. As the whole of the trunk is irradiated evenly the spine receives no more than the other tissues in the thorax and abdomen. This

large volume of tissue which is treated greatly reduces the dose which can be delivered and in my experience systemic effects such as radiation sickness and blood count changes develop before relief of symptoms is obtained. Some improvement is usually reported by the patient but in my opinion it is not so striking nor so permanent as when local therapy is given. This I think is the opinion of the majority of radiotherapists and few, if any, now use this technique.

(2) Localised radiation to the spine over a short overall time:-

In this technique the sacro-iliac joints and spinal area are irradiated by local fields, ~~as indicated in Figure~~ the whole treatment course lasting approximately two weeks. The sacro-iliac area is treated by a posterior field measuring 20cm x 10cm and the spinal area is covered by a series of rectangular fields

10cm wide and of a length best suited to the curvature of the back. I use a kilovoltage of 200 and an X-ray beam having a half-value-layer of .5 mm of copper. I give 200r each day to all the fields for 10 consecutive days, the total skin dose being 2000r and the approximate dose received on the spinal articulations about 1000r. As MacWhirter recommends I treat the whole length of the spine regardless of the extent of the disease. I have been convinced that it is more satisfactory to do this than to treat only the region radiologically or clinically involved. The disease may be more extensive than is apparent from either clinical or X-ray examination and I have seen cases in which the sacro-iliac joints and lumbar spine only have been treated with improvement, but a relapse at a high level has taken place within a few months and further treatment has become necessary. If the X-ray treatment can arrest

the disease in a high percentage of cases then it is important that the whole area of involvement is included in the first treatment course.

As hip or other joint involvement is less common however I do not treat these areas in the first instance unless there are definite clinical signs suggesting that the joint is affected. For instance, painful or limited movement of a hip I take as an indication for X-ray treatment which I give at the same time as the treatment to the spine and at the same dose rate.

In treating the female patient it is important to remember that irradiation of the sacro-iliac joints may produce an artificial menopause with disturbing menopausal symptoms. This is especially liable to

happen if the patient is over the age of 35. In younger patients amenorrhoea may develop for a time but the periods usually return after a few months. I do not think, however, that any patient who is likely to bear children should have sacro-iliac irradiation. There is strong evidence that the gene mutation rate is increased after ovarian irradiation and the likelihood of producing abnormal children is considerably increased. Some radiotherapists have attempted to avoid irradiating the ovary when treating the sacro-iliac joints by placing the patient on his side. This manoevre, they say, lets the ovary drop over to the side on which the patient is lying and they then treat the uppermost sacro-iliac joint by a beam directed obliquely from below upwards. This is not a very satisfactory procedure and I feel that it is safer to omit treating the sacro-iliacs in these

patients; the spine can, of course, be treated. Care should also be taken in treating the hip joints and the portals of entry should be limited to as small an area as possible, lest the ovary be included in the field.

Retreatment:

In a small percentage of patients who have obtained relief after X-ray treatment and who remain symptom-free for several months or years, a recurrence of pain or stiffness may gradually develop. This pain must be distinguished from the aching pain and tiredness in the back associated with a faulty posture of which spondylitics often complain. Where the symptoms are due to a recrudescence of the disease the pain is usually worst after a period of rest and relieved when he goes about. He frequently says that the new pain is now

similar to the one he had originally. When the pain is postural there is usually a dorsal kyphosis with flattening of the lumber spine. This pain comes on in the evening when the patient is tired and it is relieved by a period of rest. On examination also tenderness may be elicited on palpating the strained muscle.

If the patient originally obtained benefit from the X-ray therapy and subsequently develops pain which is attributed to a flare-up of the disease then I think it is worth repeating the treatment. On this second occasion, however, I localise the treatment to the painful area only and give the same dose as on the original course.

Most of the cases which I have had to treat a second time with X-rays have been in an advanced stage

and although the benefit derived from the second course often lasted longer than the first a later relapse was not uncommon. A few of these retreated cases, however, have remained symptom-free.

I never treat a third time as the skin in most patients will not stand further radiation without sustaining serious damage.

(3) Localised radiation to the spine over a long overall time:-

In a small group of cases I have tried the effect of prolonging the overall time of the X-ray treatment over a period of three months by giving the same dose (200r) weekly instead of daily. This technique I found equally effective in relieving the pain although it took a longer time for the patient to feel the benefit. Other things being equal, I think it is an advantage to obtain the maximum benefit from the X-rays as quickly as

possible provided there is no systemic upset and I now reserve this protracted method of treatment for the few cases who are especially prone to radiation sickness and in whom it may not be possible to give the more intensive daily treatment.

C. Physiotherapy and Orthopaedic Treatment.

Under this main heading I should like to outline the physiotherapeutic and orthopaedic measures which I advocate as an essential auxiliary to the other forms of treatment. I shall also discuss the value of:-

1. Short-wave and long-wave diathermy.
2. Infra-red radiation.
3. Spa treatment.
4. Histamine ionisation.
5. Ultra-violet light.
6. Remedial exercises.
7. Plaster immobilisation, and spinal supports.
8. Operative surgical measures.

Physiotherapy Treatment in general.

As soon as the patient comes to me for treatment I arrange for him to be seen by a physiotherapist at a combined clinic which I hold in conjunction with the physiotherapy department. The treatment policy is discussed and the prescribed physiotherapy is begun at once.

At the beginning the physiotherapist tries to teach the patient muscle relaxation. This is an attempt to try and overcome some of the muscle spasm which is frequently responsible for much of the pain, limited movement, and deformity. The patient is placed in as comfortable a position as possible with the aid of pillows and he is encouraged to relax. At the same time an attempt is made to improve the chest expansion and increase the vital capacity of the lungs. Once muscle

relaxation is obtained general and local breathing exercises are taught. The local breathing aims at increasing the lateral and apical expansion of the chest and can be taught by manual pressure.

Once the ability to relax has been taught and the breathing has improved, the next step is the strengthening of the extensor muscles of the spine, head, and hips as these have frequently undergone wasting. When the muscles are strengthened by exercises an attempt is made to improve the posture and any tendency to develop a flexion deformity of the spine is resisted by the re-educated neck muscles, latissimus dorsi, sacro-spinalis, hip extensors and abdominal muscles.

Active movements are encouraged but not if they cause pain. In this connection it is interesting to note how much more movement can be obtained by the

physiotherapist at the end of the X-ray course when much of the pain has been eased.

After the initial period of physiotherapy in which the patient is given individual attention, he joins a class of patients all suffering from the same condition as himself. Under the supervision of a masseuse they perform the exercises they have been taught and afterwards they play games specially designed to strengthen the spinal muscles. The patient is also encouraged to carry out the exercises at home.

The average period for the physiotherapy course is from two to three months but this varies according to the extent of the disease. At first the patient attends the department daily but gradually the number of attendances is reduced until he is coming only once a week for supervision and recording of movements.

If the patient is at work he is asked to attend only once a week. This is to ensure that the movement that has been obtained is not lost and that the chest expansion remains full.

SHORT and LONG-WAVE DIATHERMY.

23 of my cases had had previous treatment by diathermy. Although most of the patients said that their pain and stiffness was relieved by this treatment the benefit lasted only a few hours or at the longest, a few days. I consider that diathermy is of limited value and restrict its use to certain cases.

I use it instead of X-rays in the treatment of the sacro-iliac joints in a young female patient on whom it is undesirable to upset the ovarian function. Diathermy is also of value in the treatment of fibrositis which is sometimes found in association with the spondylitis. Frequently patients who have had X-ray treatment come back complaining of pain round the shoulder girdle and in the neck. On palpation tenderness is present and nodules may be felt in the

rhomboids or trapezius muscles and sometimes in the pectoralis major. For these patients I advise diathermy usually followed by deep massage to the muscle. A word of caution is necessary however in an area previously treated by X-rays. The dose of X-rays given is sufficient to produce some permanent skin damage and the application of the diathermy to the same area may produce a severe reaction and may even make the skin break down. I think it is safer to explain to the physiotherapist the position of the X-ray field and instruct her to avoid this area.

INFRA-RED and HEAT.

This treatment was given to 59 of my patients before they were referred for X-ray therapy. Nearly all reported temporary improvement but the period of relief was very short and in many of the cases it

lasted for only a few hours. I came to the conclusion that it was less effective than diathermy and I do not think it has any place in the treatment of ankylosing spondylitis.

SPA TREATMENT.

31 of my cases had had Spa treatment previously. Some obtained no benefit but several said they improved for a few weeks and then relapsed. I doubt if it is of much value as the primary method of treatment of this type of spondylitis. As a rehabilitation measure however it may be considered of value for a certain type of patient and recommended in order to try and recover lost movements in spine and hips. In England, Harrogate, Droitwich and Buxton are specially recommended for this condition.

HISTAMINE IONISATION.

In this treatment histamine is applied to the skin on a pad and a constant electric current is passed between an electrode in the pad and the patient, who is connected to the opposite electrode by another larger pad soaked in saline. The electric current drives the histamine ions into the skin and produces a wheal. I have found this method of treatment especially valuable in patients who have had their spine treated successfully and who subsequently develop localised pain and tenderness on some of the bony points around the pelvis, and especially at the origins of some of the muscles. This is not an uncommon complaint and if one takes a radiograph one may see localised rarefaction at the site of the pain and sometimes some irregular new bone formation. The commonest sites for this pain are

1. At the Ischial tuberosities where the hamstrings take origin. This pain is frequently quite severe and prevents the patient from sitting down in comfort.
2. Along the iliac crests in the region of the anterior superior and inferior iliac spines at the origins of the sartorius and rectus femoris muscles respectively.
3. Over the greater trochanter at the insertion of the gluteal muscles.

In these situations the bone is close to the skin surface and histamine ionisation may be carried out in the hope that some of the ions may pass to the underlying bone. In many of my cases the pain has been relieved after a few applications and I think this is the most successful method for dealing with localised pain in those extra-articular sites.

ULTRA-VIOLET LIGHT.

Ultra-violet light has no specific

action on the joint condition. It is of value, however, as a general tonic measure to enhance the patient's general resistance. It is said to increase their haemoglobin, stimulate their appetite and make them put on weight. As with short-wave diathermy and infra-red radiation, ultra-violet light must be given carefully to a patient who has had X-ray therapy. I advise the physiotherapists to expost only the front of the patient to the U.V.L. and thus avoid the skin over the spinal areas that has had X-ray treatment. I usually give this treatment to those patients whose general health is below normal and who do not seem to improve even after their symptoms have been relieved.

REMEDIAL EXERCISES.

The general principles followed in giving Remedial exercises have already been mentioned.

In the beginning the masseuse teaches the patient muscle relaxation, especially of those muscles which are in spasm. Later on she tries to re-educate the opposing muscle groups which are usually wasted or lacking in tone, e.g. in a hip joint which is involved there is spasm of the flexors and adductors and the treatment should aim at relaxing these muscles and strengthening their opponents, the extensors and abductors. At first, patients are taught spinal and breathing exercises which they perform without resistance. As the wasted muscles become stronger resistance is provided by means of the operator's hand or by placing the patient in a suspension apparatus (as for example the Guthrie-Smith apparatus) and encouraging him to perform the movement against springs, whose tension can gradually be increased. At a later stage he carries out the movements, sitting or standing, against

the weight of his own body. Once he has learnt the movements he is able to carry out the exercises at home and he is advised to spend fifteen to twenty minutes twice a day in practising them. It is important also to continue with spinal exercises for at least a year after he has been treated, and longer if there has been any recurrence of symptoms.

PLASTER IMMOBILISATION AND SPINAL SUPPORTS.

Plaster immobilisation:-

Some orthopaedic surgeons recommend that all their patients should lie in a plaster bed in the early treatment of the disease. If there is no spinal deformity however I doubt if it is necessary to put them to this discomfort and I think that probably a hard mattress is all that is required.

One method of treatment which was practised in the past was complete immobilisation in plaster for three to six months in order to allow the active disease to settle down before advising any further treatment. 41 of my patients had this carried out but I do not think that any of them showed any permanent benefit. Some said that they were free of symptoms while they were lying in the plaster but as soon as

they got out of it, their symptoms recurred. A disadvantage of the plaster treatment is the complete spinal rigidity which develops. If one argues that the disease will progress to complete rigidity in any case then this would seem a rational method of treatment. If on the other hand one believes that the disease can be arrested then I think an attempt should be made to retain any remaining spinal movement.

The type of case in which I think a plaster bed is of definite value is the patient who has a dorsal kyphosis of recent onset and in whom the bones have not yet ankylosed. By making a posterior plaster shell which fits the lumbar region but which is slightly less curved than the dorsal region it may be possible to undo the kyphosis gradually. As the

kyphosis is only slightly opened out by one shell a series of shells may be necessary. In practice however one finds that only a limited amount of improvement can be obtained and complete return to the original dorsal curve is not possible. It is a method of treatment however which should be recommended in recent and early cases of kyphosis. After the period of complete recumbency which may last from two to three months the patient should sleep in the shell for at least a year as there is a tendency for the kyphosis to recur. In all cases the plaster immobilisation should be preceded by the course of X-ray treatment.

Spinal support:-

I never recommend the use of a spinal support so long as the patient has any remaining

movement in the dorsal or lumbar regions. To give a patient a spinal support ensures that the supported region will be permanently rigid. If mobility is still present I try to encourage movement and improve the tone of the muscles so that they will be strong enough to give the necessary support to the spine. In the patient however who has a rigid dorsal and lumbar spine a support may be indicated. Such a patient often complains of pain in the lumbar region or in the inter-scapular region, the pain being worst in the evening and relieved by rest. The pain in these cases is probably due to the faulty posture and may be relieved by the use of a spinal support. The spinal support is also of value in the patient who has a rigid dorsal spine and is tending to develop a slight stoop. It should also be recommended for those patients who have been treated in a plaster bed for

dorsal kyphosis and who are now ambulant.

The two types of spinal support which I have used are (1) the Jones and (2) the Taylor. The Jones (sometimes called the Thomas) support is composed of a broad band of leather supported on a steel frame and lined on the skin surface with chamois. It is bent to the curvature of the spine and extends from the sacrum to the upper dorsal region. The body is held against the support by two shoulder straps, two crutch straps and a narrow abdominal belt.

The Taylor type of support which I now use is much lighter. It is made of two parallel bars of duralumin covered with leather and connected at their lower ends to a circular band of padded spring metal which grips the pelvis between the iliac crest and the greater trochanter on each side. A corset, 6 inches wide holds

the lumbar spine against the support and shoulder straps hold the upper part of the trunk against the upper part of the support.

OPERATIVE SURGICAL MEASURES.

Up to the present time operative surgery has played only a small part in the treatment of this condition. Within the past ten years operations have been devised for two purposes

(1) to try and improve the spinal deformity and

(2) to mobilise ankylosed hips.

(1) An attempt has been made to correct the spinal deformity by the operation of Osteotomy of the Spine. Smith-Petersen was the first to perform this operation and since he first devised it in 1944 several variants have been described.

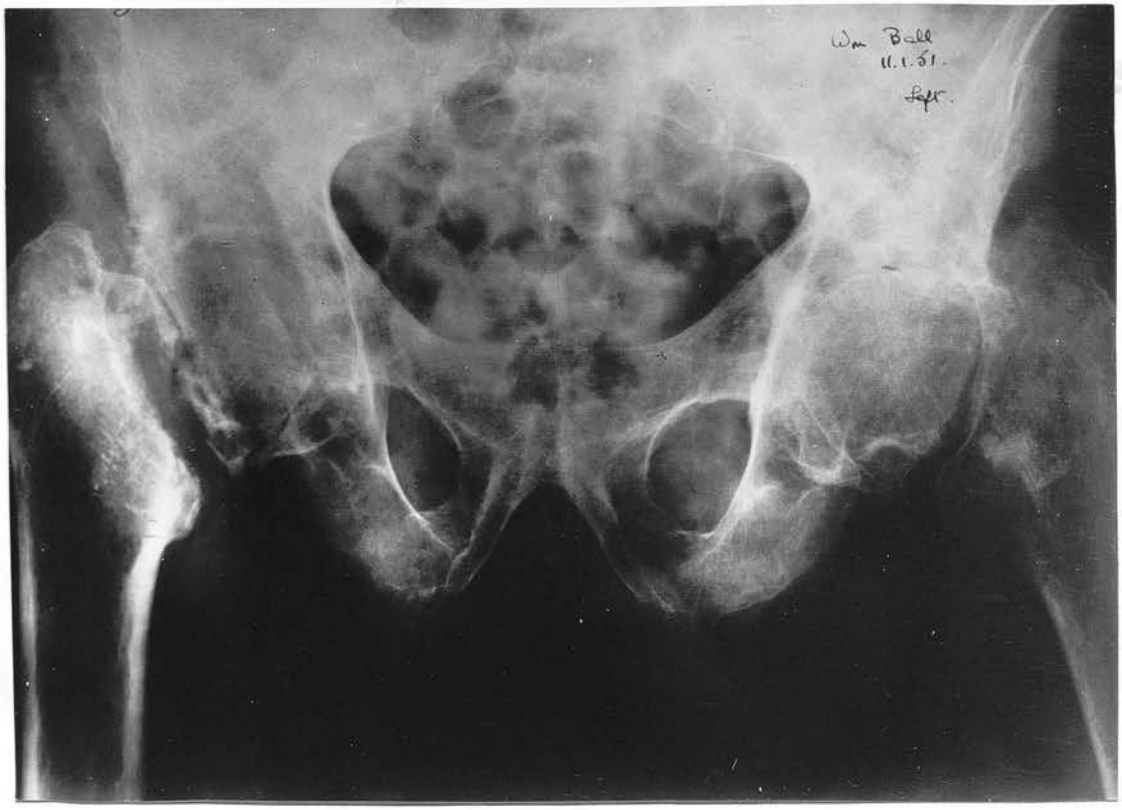
The operation aims at producing a compensatory

lumbar lordosis for a rigid dorsal kyphosis. It is always performed on the lumber region of the spine as a dorsal spine osteotomy is dangerous because of the narrow spinal canal in this region. The osteotomy which may be performed on several vertebrae is carried out through the superior articular processes of the vertebra below and the inferior articular processes of the vertebra above. The lumbar spine is then able to be hyperextended and the patient lies in a plaster bed till the bones consolidate in this position. The operative mortality is still heavy but the results should improve as experience is gained. Very few surgeons have performed this operation and at present I think it could only be considered in a patient who had an extreme degree of kyphosis but whose general health was not unduly undermined by the disease. I think one has also to remember that when the disease

is so advanced as to cause marked dorsal kyphosis the costo-vertebral joints are probably also ankylosed and the vital capacity of the chest is seriously reduced.

(2) Mobilisation of ankylosed hips:-

Arthoplasty of one or both hips may be considered when both joints are ankylosed and the patient is unable to walk. At this operation the hip joint is exposed and after the acetabulum and the head of the femur have been remodelled a vitallium cup is interposed between the bones. It is difficult at present to assess the value of this operation but it is claimed that in about half the cases a stable hip with some movement is obtained. The average amount of movement is quoted as flexion 30°, abduction-adduction 15°, rotation 10° (Law). There is however a tendency to undergo re-ankylosis after a



Excision of femoral necks for ankylosis of both hips.

year or eighteen months. Two of my cases have had this operation performed - on one a bi-lateral arthroplasty was carried out. In both cases however the bones have united again and the results were not satisfactory.

My orthopaedic colleagues at the Royal Orthopaedic hospital in Birmingham now favour an operation in which the neck of the femur is excised. They claim that the false joint which develops is stable and fusion of the bones unlikely. The cases on which I have seen this operation performed have regained some hip movement and the new joint appears to be reasonably stable. I think it is worth considering in young patients who have bi-lateral hip joint disease with bony ankylosis. Further time however will have to elapse before a full assessment can be made of its value.

RESULTS OF TREATMENT.

Discussed under sub-headings:- 1. Immediate
2. Late
3. Capacity for work.
4. Arrest of disease.

1. Immediate:-

All the cases which I have treated I have seen at regular intervals afterwards and continued the follow-up for an indefinite period. If the patients are still attending the physiotherapy department I see them monthly with the physiotherapist-in-charge but if all treatment is discontinued and they are progressing satisfactorily I ask them to report at three-monthly intervals for one year and afterwards six-monthly unless they have a recurrence of symptoms. In some cases it was not practicable to see them at intervals after treatment because they had been treated when in the Services and had gone to distant parts of the country or in a few cases they had removed out of the country. I

tried to keep in touch with those distant cases by letter and sent them a questionnaire to answer and return. Only two patients I lost touch with entirely although several had to be written to many times before they replied. As a result of this follow-up I have tried to assess and record the results of the treatment immediately and after a long interval.

The immediate benefit received by the patient after he starts X-ray treatment is quite impressive. In the average case the pain and stiffness is relieved and the general health soon shows an improvement. I am showing in the form of a table the result of the treatment as reported by the patient one month after finishing the course. Those who had/

Those who had

Considerable or complete relief of symptoms	111	68%	94%
Slight relief of symptoms	43	26%	
No improvement	8	5%	
Not known	2	1%	

I also questioned each patient as to when they noticed the improvement after they started the treatment and in the table below I am showing the answers.

Improvement	During treatment	Within a fortnight of finishing.	After a fortnight.
Slight	24	9	8
Considerable	92	12	7
TOTAL	116	21	15

In the first table, the important figures to note, I think, are the 94% representing the patients who obtained some relief of their pain or stiffness and the 68% (over two-thirds) in whom the relief was considerable or complete.

The second table shows that of those who reported

improvement by far the greatest number (116 out of 152) 76% began to feel the benefit during the time they were under treatment and usually after only four or five days had elapsed.

When one examines these patients objectively after having had a course of X-ray therapy however and compares the physical signs before and after the change is not so impressive. I tried to compare the range of spinal movement before and after and show the result below

Cases showing some increase in spinal movement	77
Cases where movement seemed to be unchanged	80
Indefinite	5

Less than half the patients showed an improved spinal movement and in most cases this improvement was only slight. Considering the fact that most of the patients had some physiotherapy during the X-ray treatment I think one can say that the subjective benefit is

considerably greater than the change in the physical signs and that X-rays do comparatively little directly to increase the range of movement. By relieving pain however it can permit intensive physiotherapy to be given and the range of movement gradually increased over weeks or months.

2. Late:-

I have made a later assessment of the value of the treatment in 61 of my earlier cases treated between 1944 and 1947. These were unselected cases, and I think represent a true cross-section of the whole group. Two years after treatment I found:-

Patients entirely symptom free	23	38%	91%
Patients improved but still having some pain or stiffness	32	53%	
Patients not improved or worse	6	10%	

Admittedly these numbers are not quite so large as one

would like but they show that about 90% of all cases treated showed symptomatic improvement after two years and were better than formerly. 38% were entirely symptom free and leading a fairly normal life.

On reviewing the case notes of those patients who obtained no benefit and in whom the disease seemed to progress I found they were almost all advanced cases when first treated. In addition to their whole spine being involved many had the disease in their hips and other joints.

On the other hand the 38% who were symptom free contained a higher proportion of early cases and 17 out of the 23 had only sacro-iliac joints or sacro-iliacs and lumbar spine involvement. The chance therefore of relieving symptoms for a prolonged period and apparently arresting the disease is much greater when it is in an early stage.

3. Capacity for work:-

In spite of the limitation in the spinal movement the patient may be able to resume his employment. At the follow-up attendances I asked each patient the date of their return to work. Out of my total 76% had returned to some form of work within three months, while nearly 90% had attempted work within a year of treatment. The remaining 10% had not resumed work at one year.

These figures can be put alongside the results reported by Frank P. Foster and James D. Gillespie of the Lahey Clinic at the 7th International Congress on Rheumatic Diseases, on 100 cases treated by X-rays and observed over an average period of 15½ years.

88% of their patients were at full-time work
9% of their patients were at part-time work
3% of their patients were totally unable to work.

As one would expect the more advanced the disease the longer was the delay before returning to work. In the table below I am showing the average time before return to work compared with the extent of the disease at the time of treatment.

Area involved by Disease	Return to work Average time in months.
Sacro-iliac joints only	2.3
Sacro-iliac joints and lumber spine	3.0
Whole spine	3.3
Whole spine with hips or other joints	11.2

In the last group the figure was assessed on those who returned to work although there were many others who were unable to return.

Most of the heavy manual workers (miners, labourers etc.) were unable to go back to their former occupations but many found lighter jobs in the firms with whom they

had previously been employed. The light manual workers and those following most of the other occupations were able to resume their ordinary employment. The group that presented the greatest difficulty were the self-employed artisans who were unable to continue with their work and had no lighter job to which they could turn their hand.

To those patients who found difficulty in finding work because of their incapacity the Ministry of Labour was able to offer some help. The Ministry holds a Register of Disabled Persons to which spondylitics (after medical certification) may have their named added. In conjunction with the employers the Ministry tries to place these disabled persons in suitable posts. If however they are unable to follow their old employment a Rehabilitation Course lasting eight to twelve weeks

at which intensive training is given for a more suitable occupation depending on the ability and aptitude of the trainee. Several of my patients have attended such a course and in a short time have trained for such skilled jobs as wireless servicing engineer, typewriter mechanic, and watch repairer.

In the rehabilitation of cases of ankylosing spondylitis the psychological factor is extremely important. I encourage the patients to return to work as soon as possible because I find that the longer they are inactive the more difficult does the resumption of their full duties become. If a patient is already at work and he develops a temporary recurrence of pain or stiffness I try and persuade him to continue with his work despite the fact that he may be suffering slight discomfort. Once he stops working his symptoms become exaggerated and it may be increasingly difficult to get

him to go back.

If the patients have been off work for several months they tend to become obsessed by their spinal symptoms and are never without some complaint. These patients are difficult to deal with and in some cases become unemployable. This state of affairs should be prevented by reassuring him at an early stage in the disease and telling him of his future prospects.

Ministry of Pensions.

37 of my cases were under the care of the Ministry of Pensions who undertook to arrange for their treatment and follow-up care. I got the impression that the Ministry were fairly reasonable in the granting of Pensions. They appeared to accept responsibility for those cases whose symptoms developed first during war service. In many of the cases whose

symptoms dated back to before the war they considered that the war service had aggravated the condition and also allowed a Pension.

4. Arrest of Disease

In addition to the relief of symptoms, the improvement in clinical signs and the increased capacity for work, I consider that X-ray treatment can, in some cases, arrest the disease. It is difficult in a condition of this character which is liable to recur after a long interval to know when it has ceased to be active. I consider however that in 75-80% of the early cases where the sacro-iliac joints only or the sacro-iliacs and lumbar spine are involved that the disease is arrested at this stage, and further extension prevented. In the more advanced cases where the dorsal or cervical spines are also involved about 50% of the patients show no signs of later extension. When the hips or other joints are involved in addition to the spine, the chance of arresting the disease is further diminished.

In general, I think one can say that the earlier the disease, the greater the chance of its being cured by X-ray therapy.

RECENT ADVANCES.

Aetiology:

A thesis put forward recently by Hans Selye of Montreal postulates that much non-specific disease is due to certain "stresses" on the organism. These stresses may take the form of nervous or emotional strains, toxaemias or infections. Normally, the body adapts itself to these stresses by certain biochemical reactions evoked by the pituitary and the adrenal cortex. A state of health is thus maintained, but depending all the time, on the integrity of the pituitary and cortex of the adrenal gland. If these reactions of the pituitary or cortex are abnormal, or fail, then the body tends to fall victim to one of certain diseases which Selye terms "diseases of adaptation". These diseases can be divided to three sub-groups comprising

the diseases due to hypo-, hyper-, and dys-adaptation depending on whether the derangement is chiefly due to a deficiency, an excess, or a distortion of the adaptive response.

The diseases of adaptation cited by Selye are many and varied, affecting one tissue or organ in one individual and a different one in another. The vulnerable tissue has been called the "Target-organ" hence the disease may manifest itself by such conditions as rheumatoid and other forms of arthritis, ulcerative colitis, peptic ulcer or thyrotoxicosis depending on the target-organ.

This theory assumes that the effect of long-continued stress falls on the anterior pituitary which then secretes an increased amount of the hormone (adrenocorticotrophic hormone) A.C.T.H. which stimulates the adrenal cortex.

The cortex in turn produces corticotrophic hormones which may be of two types: (1) the gluco-corticoids which produce changes in organic metabolism by raising the blood sugar as part of the body's defence mechanism and (2) the mineralo-corticoids which produce changes in organic metabolism mainly by means of sodium retention. The proof that these actions are produced by specific substances still awaits confirmation but there is no doubt that the adrenal cortex can produce a large number of hormones which exert different actions. They include such substances as cortisone, Kendall's compound F, dehydrocorticosterone, and corticosterone.

Selye considers that a derangement in the glucocorticoid - mineralocorticoid balance is an important factor in causing arthritis of such types as rheumatic arthritis, Still's disease, rheumatoid

arthritis and ankylosing spondylitis. This derangement may be precipitated by such "stress" factors as focal infections, trauma and emotional disturbances.

His thesis supports the view that the adrenal cortex plays an important part in the pathogenesis of ankylosing spondylitis - a view that was suggested by the work of Davison, Koets and Kuzell on 17-ketosteroid excretion. Although not completely proved Selye's hypothesis correlates many independant and apparently unconnected observations and gives us a new concept of the pathology of a wide variety of diseases.

RECENT ADVANCES.

Treatment:

Hench and Kendall found that large doses of cortisone or A.C.T.H. administered to patients with rheumatoid arthritis produced a dramatic and instantaneous improvement in the condition of the joints. Similar results have been reported in a few cases of spondylitis that have had treatment by A.C.T.H. It is still too early to state the full value of this new method of treatment and of the dangers which may attend the prolonged administration of these new substances. It may be that cortisone or A.C.T.H. will become established as the method of treatment in the future. So far a sufficiently large number of cases have not been treated and it will be some time yet before adequate supplies become available for a large-scale

clinical trial.

It would seem reasonable however, in the first place, to reserve cortisone for those cases which have proved to be resistant to X-ray treatment or have not been completely relieved after the course of X-rays. Cortisone or A.C.T.H. treatment may also be indicated in those advanced cases in which the hips, knees or other joints are involved in addition to the spine. The evidence suggests that in these advanced cases cortisone may partially undo some of the damage already caused by the disease.

SUMMARY AND CONCLUSIONS

The disease of Ankylosing Spondylitis is defined.

In a brief historical note the early records of the disease are mentioned in addition to the classical descriptions given by Marie, Strumpell and Bechterew and the modern view that the descriptions given by these three writers represents variants of the same disease is re-asserted.

A note on the pathology of the condition affirms the well-accepted view that the disease starts in the sacro-iliac joints and later affects the spine, spreading upwards from lumbar to cervical regions. Other joints may be affected later. The macroscopic and microscopic changes seen in the spine are described.

The writer's cases number 164 - 145 men and 15 women seen during the years 1944-1950. The age and sex incidence are discussed and the possible aetiological factors are investigated. The findings suggest that no single factor is responsible but that the disease is probably a function of many causes, in particular sepsis, trauma, shock and fatigue. This view corresponds with a recent hypothesis of Selye who regards this condition (along with many other diseases) as the end-result of many 'stress' factors acting over a prolonged period. The reason for the disease affecting the sacro-iliac joints and the spinal articulations, especially in the male, cannot be clearly explained, but MacWhirter's view that a prostatic hormone acting through the paravertebral venous plexus may be responsible, provides an interesting hypothesis.

The symptomatology is discussed and the intermittent nature of the early symptoms is noted. As the disease spreads upwards in the spine the change in the subjective features is described. Attention is drawn to the fact that occasionally the condition may progress to an advanced stage without giving any symptoms.

The physical signs are described and photographs of spinal tracings are shown which demonstrate the limited spinal movement as the disease spreads upwards. Lateral flexion of the neck and external rotation of the hip are the first movements to be limited when these areas are involved.

The radiological changes are noted - viz. erosion in the juxta-articular areas of the affected joints with sclerosis of the surrounding bone, and loss of the clear line

of the joint being the characteristic changes seen. Photographs are shown of symphysis pubis and manubrio-sternal involvement. Bone changes at extra-articular sites are described, and photographs are shown of changes in the ischial tuberosities.

The value of the blood sedimentation rate estimation is discussed, and its change during and after X-ray treatment is noted. The conclusion is drawn that the B.S.R. is of little value in assessing prognosis except if it is raised to a high level when it indicates active and progressive disease.

The treatment which the writer adopts is discussed under the headings of 1. General medical treatment, 2. X-ray treatment and 3. Orthopaedic treatment. The general medical

treatment includes rest, removal of septic foci, relief of pain and treatment of anaemia. The action of X-rays in spondylitis is discussed and indications for X-ray treatment are given. The long interval between the first symptoms and the time of treatment is deplored and a plea is made for earlier X-ray treatment instead of other forms of physical therapy. X-ray technique is discussed, and in the writer's opinion localised treatment to the spine over a short time is considered the method of choice - a dose of 2000 r. in 2 weeks being given to the sacro-iliac joints and whole length of the spine in every case. The precautions necessary when treating the female patient are mentioned, and indications for re-treatment are also discussed.

Physiotherapy is regarded as an essential auxiliary to the other methods of treatment and the techniques adopted are given. The value of special forms of physiotherapy (diathermy, ultra-violet light, spa) and their place in the treatment is indicated. Histamine ionisation is suggested as a satisfactory method of dealing with painful extra-articular disease. The indications for the use of plaster beds and spinal supports in correcting dorsal kyphosis are given. Recent operative surgical measures adopted to correct deformity include Osteotomy of the Spine and Arthroplasty of the Hips, and the possible value of these operations in the advanced case is mentioned.

The results of treatment are discussed under four sub-headings - immediate, late, capacity for work, and arrest of disease.

94% of all patients obtain some relief of pain or stiffness after X-ray treatment, and 68% obtained considerable or complete relief which came on during the time they were having the treatment. Less than half the patients, however, showed any improvement in spinal movement, although the vital capacity was slightly increased in all the cases on which it was measured.

At a later survey after 2 years 38% of the patients were symptom free and leading a normal life, and a further 53%, although much better than formerly, still had some pain or stiffness. 10% did not feel they were any better after 2 years, but these cases were nearly all in the advanced stage.

76% of all patients had returned to some form of work within 3 months of treatment, and nearly 90% had attenpted work within a year.

In general the more advanced the disease, the longer was the delay before returning to work. The psychological importance of getting the patients back to work early is stressed.

The writer gives his opinion that the early case of ankylosing spondylitis can be cured by X-ray therapy in 75% of cases, but in the advanced cases the chance of arresting the disease becomes less depending on the extent to which it has progressed.

The last section deals with recent theories on the aetiology of the disease suggesting that the adrenal cortex and pituitary may play an important role in its pathogenesis. In the future, cortisone or A.C.T.H. may become established as the method of treatment, but as long as supplies are limited it is suggested that this treatment should be reserved for those cases that have been found to be resistant to X-rays.

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